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YOUR EXPERT GUIDE TO TODAY'S TECH
#528 JANUARY 2024

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Good things to do

During the summer holidays

Merry Christmas, dear *APC* readers! This issue officially goes on sale on Christmas day (subscribers get theirs a few days earlier, so, please consider subscribing), but I do hope you're doing *anything but* reading the latest issue on Santa's big day itself.

Boxing Day, though, what a lovely opportunity to chill with your new collection of *APC* features, guides, reviews and opinions. We've put a bit of an emphasis on guides and projects in this issue. In fact, we usually do this for the couple of issues leading up to Christmas as well, hoping that it gives you some nice holiday projects to immerse yourself in.

So let's start with the fun stuff, and get on with some excellent retro gaming. Whether you're a reader of some vintage, or a fresh young type, it's all here for you on page 74. Have a read and see what you like, we have many platforms covered and it's really pretty straightforward to get set up, leaving you all good to go with some classic gaming in short order.

Less fun, but potentially much more satisfying is our PC repair guide, that's on page 66. Christmas time is tinker time, here at *APC*, and I know quite a few of you will have big and small issues that need correcting. I have a reasonably long list, myself, of well overdue troubleshooting to take care of. We've collected solutions to many common problems, so this issue of *APC* is worth keeping around just in case something goes bad in the future.

Even less fun, but probably more important than anything else, is ensuring your device security. 2024 is a whole new ballgame and you need to stay a step ahead of the bad guys. We've split this into two sections – the first guide covers the devices you use personally and around the home (starting on page 58), while the second part is for anyone that's responsible for keeping a business of any size secure (page 62). That goes for solo operators and SMBs, and our security expert Davey Winder has a comprehensive run-down of what evil is likely to rear its head through the course of next year. Be prepared! Alert but not alarmed, we always say...

Plus all the rest of the ingredients that make up this issue of *APC*. We've all enjoyed this year in tech, even with the ups and downs 2023 has been more than satisfying. We at wish you and your family all the best for the Christmas break, and a very happy new year!

"Christmas time is tinker time, here at *APC*, and I know quite a few of you will have big and little issues that need correcting."

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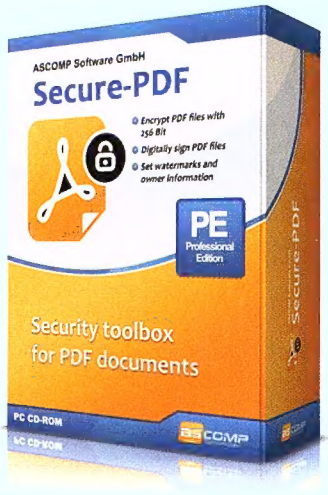

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SECURITY TOOLBOX FOR PDF FILES INCLUDING ENCRYPTION AND SIGNING.

The PDF format is used worldwide to distribute graphically processed documents. However, editing the documents is usually associated with high costs because good PDF editors are quite expensive. The cheaper alternatives on the other hand, lack the important functions to make PDFs secure, for example by encrypting, digitally signing or adding watermarks.

Secure-PDF puts an end to this: Encrypt your own or other people's PDF documents with up to 256 bit key strength (AES). Add a password to open it so that users can only view the encrypted document by entering the correct password.

ASHAMPOO PHOTO OPTIMIZER 9

ENHANCE PHOTOS WITH A SINGLE CLICK.

Ashampoo Photo Optimizer 9 offers automated editing for single images or entire image folders at the click of a button. it takes just a single click to have the program analyse each photo extensively and to detect and fix all issues, from poor lighting and underwhelming contrasts to colour errors. Nothing gets past Photo Optimizer's sophisticated algorithms! The built-in split-view makes it easy to compare results against their originals and every action is instantly reversible. If you prefer to enhance your photos manually, you'll find a broad range of common and creative tools to do so. Perspective issues, red eyes, skin impurities or spots, that ruin so many portrait shots, are now gone in a matter of seconds.

AUDIALS MUSIC 2024 SPECIAL EDITION

ENJOY STREAMED MUSIC ON YOUR HARD DRIVE.

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NAND suppliers' revenue market share.

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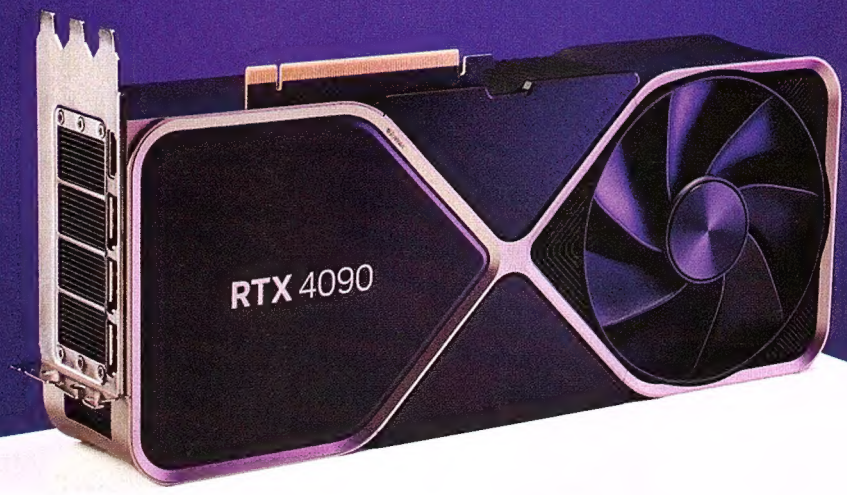
TECHNOTES

Everything you need to know from the month in tech



US govt. fires a warning shot at Nvidia

"We cannot let China get these chips".

Nvidia's penchant for redesigning its GPUs to get around US export restrictions has seemingly been directly called out by the US Commerce Secretary, with a warning that when such redesigns are created "I'm going to control it the very next day."

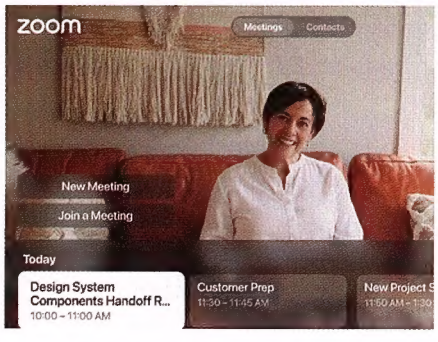
Since 2022, US chip sanctions have continued to make life somewhat difficult for manufacturers looking to export their products to certain countries, chief among them on the list being China. However, that hasn't stopped Nvidia from attempting to work its way around the export bans by releasing products that circumvent the current restrictions, introducing slightly redesigned models produced exclusively for the Chinese market.

It's been an entertaining power play, but US Commerce Secretary Gina Raimondo appears to have had her fill of the one up-manship. According to *Fortune*, she made some particularly pointed comments on the subject during the Reagan National Defence Forum in California in early December.

"We cannot let China get these chips, period" she said. "We're going to deny them our most cutting edge technology." And then more pointedly: "If you redesign a chip around a particular cut line that enables them to do AI, I'm going to control it the very next day"

Given Nvidia GPUs and its associated Tensor cores are particularly efficient at working with AI, it's no surprise the change in language here is becoming more direct and the comments more pointed. Nvidia in particular has been quick to redesign its products to beat the sanctions, including what appears to be a hamstrung RTX 4090 designed to get past the restriction on total processing performance (TTP) and performance density (TD), the two metrics currently used to judge whether a consumer GPU can be exported to restricted markets.

Of course, it's not just China that chipmakers are currently restricted from exporting to, but it appears clear from these comments that stopping the supply here is the focus for the US Department of Commerce. However, China represents a gigantic market for any chipmaker, and it's no surprise that a game of whack-a-mole would begin between those who make the restrictions and those who seek to make a profit.



YOU CAN NOW DO ZOOM MEETINGS ON APPLE TV

ZOOM APP COMES TO AN APPLE TV NEAR YOU.

In an effort to shoehorn its video conferencing platform into the hands of even more customers, Zoom has added support for the Apple TV with its 'Zoom - for HomeTV' app. The app, which is a separate App Store listing to the iOS and iPadOS app, supports second-generation Apple TV 4K models and newer.

With extended support for the big screen, the Apple TV app will be just as useful in an office meeting room as it would be for a family's living room TV. From the Apple TV app, users will be able to join existing calls and start new ones. In-meeting chat, breakout rooms, and calendar integration promise to make it as powerful as the regular desktop app.

© Nvidia, Zoom

EA PATENT WOULD USE AI TO REPLACE VOICE ACTORS

SOUNDS LIKE AN UNMITIGATED DISASTER.

EA Games has filed a patent titled "Generating speech in the voice of a player of a video game", which is made with the goal of allowing for in-game characters to be fully voiced by the player. In order for this functionality to work properly, lots of "input data" (meaning mostly speech samples, but also text samples) is required. The patent itself spends a considerable amount of time documenting the technical features of how input data is processed, but the game design implications are that AI will generate conversations with NPCs instead of giving a voice to an onscreen character.

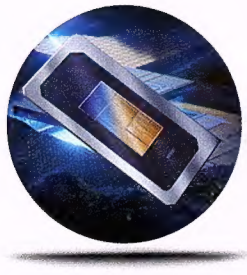
Adopting technology like this seems like a pretty sharp step backward from an industry that's been selling video games to us with face-scanned screen actors for the better part of the past decade.

CHROME UPDATE SHOWS WHICH SITES ARE SLOWING YOUR PC

AND IT'S ABOUT TIME.

A new addition to the desktop Chrome browser lets you to see each tab's memory usage, which could help you track down which sites are slowing down your laptop.

Google has rolled out a feature that reports memory usage on individual tabs when you hover over them in your browser. The feature is now available on most desktop platforms including ChromeOS, Windows, and Mac, as long as you're running Google Chrome version 119 or later. As well as displaying the domain and page name, Chrome tabs include a mini report that shows each page's RAM usage. The report includes information about memory consumption being caused by the content the tab is displaying, in addition to any background processes that are consuming memory.



INTEL TO SPEND $21 BILLION ON MAKING NEW CHIPS AT TSMC

MORE BLUE TEAM CHIPS AT TSMC.

Intel will allegedly place $6 billion worth of orders with TSMC in 2024 to fab 3nm CPU tiles, per a report from semiconductor analyst Andrew Lu. 2025 will also see a large number of Intel chips produced at TSMC, with orders totalling $10 billion. Lunar Lake is allegedly Intel's first processor to have its CPU cores fabbed at an external foundry, and Lu believes Intel will become increasingly dependent on TSMC in the future.

TSMC's 3nm node is the company's latest, and right now, it's primarily known for being the process that powers Apple's latest M3 and A17 processors. However, the analyst claims Intel will become TSMC's second-largest 3nm customer, displacing AMD, while Apple remains the largest.

© Intel

Each Bitcoin transaction uses 16,000 litres of water

Enough to fill a swimming pool.

Cryptocurrency mining, mainly with Bitcoins and Ethereum, has always been controversial due to the energy and resource consumption required to mine the currency. However, Bitcoin has a new concern, as a recent report outlines that it uses 16,000 litres of fresh water for every single transaction, either for buying or selling. Because of these transactions, many countries could face freshwater shortages if the currency becomes more widely adopted.

A detailed report from *Cell Reports Sustainability* emphasises Bitcoin's impact on worldwide water. This study was done by a data scientist at DNB and a researcher for VU Amsterdam, Alex De Vries, who stressed that its water consumption footprint has increased over the years. He also calculated that the computational process behind the Bitcoin network uses 8.6 to 35.1 billion litres of water annually in the United States or roughly one swimming pool's worth of water per transaction. The study includes both direct and indirect water footprints, both of which are from freshwater sources. These data centres consume water for cooling systems and air humidification to maintain these servers.

> "Many countries could face freshwater shortages if the currency becomes more widely adopted."

SOME GOOGLE DRIVE USERS SAY THEIR FILES HAVE VANISHED

GOOGLE IS INVESTIGATING.

A small number of Gdrive users have reported the loss of files on Google's support forum. At the time of writing, there were 347 users saying 'I have the same question'. The thread describes situations where data had vanished to as far back as May 2023. Some users have paid accounts, while others report the loss of business data.

Subsequent attempts at recovery failed. Google is investigating, with a Google employee advising users not to disconnect an account from within Drive for desktop or delete or move the app data folder. The root cause of the issue is publicly unknown, but for now, the obvious recommendation is to backup your files locally or use an alternate provider in the meantime.

Ukrainian units are using Starlink to good effect in battle.

The broadband battlefield

How has Starlink changed the face of modern warfare? James O'Malley investigates.

If someone had asked you early last year to predict the key figures in a hypothetical war between Russia and Ukraine, you probably wouldn't have named Elon Musk. But as we've seen over the past 18 months, the mogul behind Tesla, SpaceX and now Twitter, has played a surprisingly pivotal role in the war thanks to Starlink, SpaceX's satellite broadband network.

> "Starlink gives one person the ability to turn off a system that's being used by a country that's fighting for its self-defence."

First deployed in 2019, the Starlink network now has more than 4,000 satellites in orbit around the Earth, and the company continues to launch a couple of dozen or so on a weekly basis. Unlike previous attempts at satellite internet, what makes Starlink unique is that satellites are much closer to the ground, in Low Earth orbit (LEO), which reduces signal latency and increases speeds, as each satellite covers a much more narrow patch – so can devote more bandwidth to each individual user.

As a result, Starlink subscribers can expect download speeds of between 25 and 220Mbits/sec and uploads of between 5 and 20Mbits/sec. Not bad at all for satellite internet.

The service's near-global availability means it's hardly surprising that, soon after Russian tanks crossed the Ukrainian border in February last year, Starlink was quickly identified as a critical tool for the battle ahead. By May, only three months later, 150,000 Starlink terminals were reportedly in use by Ukraine.

Today, it is thought that most Ukrainian units have at least one Starlink terminal in their arsenal. And that means, for better or for worse, Elon Musk's company has played a pivotal role in the conflict.

Improving aim

Consumer drones, another new technology, are transforming how artillery is used. By using drones as scouts when shelling an enemy position, soldiers can more quickly correct their aim for a more accurate hit next time around. With high-bandwidth connectivity added into the equation, this crucial 'correction' can be even more accurate than relying on radios.

"A drone reconnaissance unit can relay footage back to an artillery battery, which is actually performing the fire mission, and then they can correct rounds onto a target in real time," said James Rushton, a security analyst based in Kyiv. "Instead of just talking about it, they can see exactly where the rounds are landing, and then they can just essentially correct in real time."

It's a tactic that is already commonplace, to the extent that Ukrainian forces have even developed an app to mount strikes, which has been nicknamed "Uber for Artillery".

"It is essentially standard operating procedure for them to use live video to correct artillery," said Rushton.

This isn't the only advantage on the battlefield, though. Rushton revealed how Starlink-relayed video footage is also being analysed by image-recognition software in the cloud to identify the tell-tale silhouettes of enemy hardware – and how Starlink combined with 3D printers has given troops in the field the opportunity to print any tools they need.

Similarly, Moore talked about the big opportunities for telemedicine – essentially connecting field hospitals with expert doctors who could be anywhere in the world, to provide better care to the injured.

And of course, there is one other advantage – giving troops an occasional sense of their former lives. "Even if he's like taking a break in a position close to the front lines, the fact that he can have a connection to the real world is good for relieving combat stress, and for connecting him to the 'normality' of the real world," said Rushton. "Because you can go out of your mind if you're just in a foxhole getting shelled and you have no way to relieve that sort of stress."

Musk intervention

Starlink's ability to assist Ukrainian forces meant Elon Musk was widely viewed as a hero in the country in the early days of the war, according to Rushton. However, Musk's reputation took a serious hit after allegations emerged in Walton Isaacson's biography of Musk that the man himself had thwarted a major Ukrainian assault on Russia's naval fleet in the Black Sea.

As part of the planned attack, Ukrainian engineers had rigged a number of seaborne drones with explosives – using a Starlink terminal to control the drones. "You can't just program a seaborne drone to sail to a location and detonate," said Rushton. "You have to guide it onto a target because ships can move and will attempt to evade the drone if they detect it."

But as they launched the assault they discovered a problem. Starlink had always been restricted by SpaceX from working in occupied Crimea, where Russian ships were close to the port of Sevastopol. So, Ukraine asked Musk to lift the 'geofence' on the system – but Musk refused, later citing his fear that such an attack could escalate the conflict into a major war. Consequently, the attack was unsuccessful and the unguided drones reportedly washed ashore.

Though the precise details of how the incident unfolded are disputed, it did make one thing clear: a powerful strategic warfare asset is effectively under the control of one man.

"It's incredibly well designed, but the fundamental issue with Starlink is that it gives one person the ability to turn off a system that's being used by a country that's fighting for its self-defence," said Rushton.

Since the incident, there has reportedly been a shift behind the scenes, as the US Department of Defense is thought to have more control over where and when the Starlink system is used.

"A drone reconnaissance unit can relay footage back to an artillery battery, which is actually performing the fire mission, and then they can correct rounds onto a target in real time."

An iPhone moment

Ultimately, what's clear is that satellite broadband is changing the future of warfare. What we're witnessing in Ukraine will be studied by militaries around the world – and any future deployment of British troops will surely take similar connectivity into account.

"What LEO connectivity means is that you can actually turn [the traditional] model on its head and you can get large amounts of bandwidth at low latency wherever you are on the planet to the tactical edge, be it in a cockpit, be it in a trench, or a vehicle or on a ship," said Moore. "What that means fundamentally is that commanders now have different options on how they can configure their military forces."

It's also clear that we've barely begun to explore the ways in which such connectivity could be used. "For me, it's like the Steve Jobs iPhone moment," said Moore. "When it was invented, they didn't know all the use cases that will come."

"We're going to get a whole world of new use cases that are going to revolutionise the way that people communicate." ■

In the videogame industry, a game is either thriving or dead

GTA 6 shows what success is in 2024, but can the rest of the industry keep up? Asks Shaun Prescott.

The long-awaited trailer for *Grand Theft Auto 6* released in early December, and at the time of writing, in the days following its release, it has 103 million views. That's an absolutely astounding number.

Rockstar and its parent company Take-Two were aware, of course, that this trailer would do unbelievable numbers, and both are likely also aware that the billions invested in the game will probably be recouped within months of its projected 2025 release. It's predicted that *GTA 6* has a budget reaching $2 billion. For reference, *GTA 5*, released in 2013, had a budget of around $265 million, and has since made $7.7 billion. Crucially, that number continues to grow thanks to *GTA Online* and a handful of reissues.

The videogame industry is a very different beast to what it was in 2013. At the cusp of the PS4 / Xbox One era, big studios still specialised in doling out a small handful of big-budget titles a year. These would be relentlessly promoted in the months leading to their release. Then, unless the game became a huge phenomenon, it'd basically disappear from the public consciousness. Even if it was a success, it was unlikely to continue to be profitable months after launch.

A company rendered "modest" next to the likes of Rockstar or, say, a first-party Sony studio, cannot do this anymore if it hopes to be sustainable. It's the province of AA institutions and indies, though even those tiers of the industry are in great stress in 2023. Now, the huge investments made in game development nowadays need to yield profitable results for a long time, because development is nowadays extraordinarily expensive. Games must live and breathe for – at worst – at least a couple of years. And we're not talking exclusively about the likes of *Fortnite* and the typical "Game As A Service" mould – this also goes for single player games like *Cyberpunk 2077* and *Starfield*.

Sure, both of these games have and likely will receive DLC and expansions, but these ye olde forms of post-launch support come from a different era. Games have two post-launch conditions now: alive or dead. Whether single player or a battle royale, in the blockbuster realm it's very bad to be "dead". *Starfield* has been proclaimed "dead" numerous times by prognosticating redditors, presumably because a day passed when it didn't feature in the headline of *PC Gamer*, or *IGN*. Games vie for cash, yes, but mindshare is a close second runner.

Some studios have shown signs of canny adaptation. Both Ubisoft and Sega have released "bite-sized" *Assassin's Creed* and *Yakuza* installments priced at around the $89 mark. While both games are comparable in size to a full-priced game by the standards of say, 2010, it's one way for prestigious blockbuster studios to keep audiences happy while they work on big budget projects that can take up to a decade to develop.

Is all this becoming a bit unsustainable, though? While there are publishers and studios capable of making the kind of money that Rockstar does, others will try to match them – even with a fraction of the resources. But it's impossible for every game publisher to earn the cache that Rockstar has nowadays. Perhaps CD Projekt had a chance, but the pressure to get a hugely ambitious multi-million dollar RPG out the door to a deadline saw them on the backfoot. Meanwhile, Bethesda can spend eight years on an ambitious space game that engenders not much more than a collective sigh. You can't just throw money at a project anymore and it'll work. *GTA 6* likely will, but it'll be an exception to the rule. ■

Shaun Prescott is an Australian editor for PC Gamer, GamesRadar and PLAY, and writes for APC, TechRadar and more.

AMD fires up AI arms race

The battle for powering the next big tech revolution has begun with AMD finally competitive in the potentially US$400 billion AI accelerator space.

Three of 2023's biggest consumers of AI GPUs: Microsoft, Meta and Open AI, have pledged to use AMD's recently announced MI300X AI accelerator for future machine learning applications. The California-based microprocessor manufacturer announced at an investor press conference in December that it will be focusing on capturing some of Nvidia's market share in the fast growing commercial AI arena for 2024.

Nvidia announced plans to triple production of its $40,000 Hopper H100 GPUs following unrelenting demand for the hardware powering novel AI software like ChatGPT in 2023. With wait times of up to 52 weeks according to one Omdia report, it's hardly surprising that Meta and Microsoft have already purchased AMD's MI300X GPUs for various workloads and virtual machines. Microsoft even had a preview version of it's Azure AI virtual machine up and running for consumers to test at the time of the AMD announcement.

AMD CEO Lisa Su said in a recent investor presentation that the MI300X is the "highest performing AI accelerator in the world" offering comparable performance to Nvidia's H100 GPU but with 10-20% better inference capabilities. A bold claim that could mean it's genuinely competitive with Nvidia's unreleased H200 AI accelerator.

While pricing for AMD's new AI accelerators was not public knowledge, Su told reporters that AMD's offering would have to cost less than Nvidia's in order to steal market share. Even though it has made excellent gaming graphics cards for the last few years now, AMD has struggled to convert meaningful numbers of customers, capturing just 12% of the desktop GPU market in the first quarter of 2023 and only being able to convert 2.7% of the mobile graphics for laptops. Su was keen to point out that the projected AI processor market continues to grow, so AMD's success is less dependent on beating Nvidia, telling the media that "We believe it could be US$400 billion-plus in 2027 and we could get a nice piece of that."

The new MI300X's performance improvements largely stem from additional memory bandwidths, which has been a bottleneck for large language models. The MI300X has 2.4 times the memory capacity of the H100 and 1.6 times the memory bandwidth. On paper it's also ahead of Nvidia's recently announced H200, which is planned to launch in the second quarter of 2024. Nvidia's H200 will have 141 GB of memory that runs at 4.8 terabytes per second, which is close to 30% less than the MI300X's 192GB high bandwidth memory allocation of 192GB at 5.3TB/s.

AMD is also offering an APU known as the MI300A which will power HP Enterprise's El Captian supercomputer that is expected to become operational in 2024, so it would seem AMD is already in a strong position to compete for AI market share into 2024. This sentiment was supported by the market which rallied around 10% on the day following the investor conference. ■

"Nvidia announced plans to triple production of its $40,000 Hopper H100 GPUs following unrelenting demand for the hardware powering novel AI software like ChatGPT in 2023."

Joel Burgess is one of the senior journalists on APC magazine and apart from being the resident laptop, monitor and fitness tech geek, he's also pretty into surfing his local Sydney beach breaks when he's not in front of a screen.

G-Sync vs FreeSync

How AMD's FreeSync standard quietly won the VRR war.

Variable Refresh Rate (VRR) displays were a hot topic when Nvidia revealed G-Sync in 2013. Tying monitor refreshes to the availability of new data from the GPU didn't immediately catch on, in part because G-Sync required a new monitor and an Nvidia GPU. AMD announced its FreeSync standard in 2014, with the first solutions appearing in March 2015.

Eight years later, there's little doubt about which technology won out. G-Sync still exists, but the number of new 'true' G-Sync displays – as opposed to G-Sync Compatible options – has dwindled to almost nothing. For example, Nvidia lists just 23 G-Sync Ultimate monitors. Those are supposedly the best displays Nvidia and its partners offer, and most of these are several years out of date. If you want a 4K monitor, there are only ten G-Sync Ultimate options, compared to 79 G-Sync Compatible Solutions, all with a maximum refresh rate of at least 120Hz.

"This is all we wanted: someone to test monitors and ensure they function as intended. That should have been VESA, but it was a bit late to the party."

I've used G-Sync displays for most of the past eight years, and they've been mostly fine – for Nvidia GPUs. On AMD and now Intel GPUs, those same displays only work as fixed refresh rate solutions. Even worse was the Acer X27 G-Sync Ultimate display. The display looked great, but the fan that's required to keep the FPGA G-Sync module cool died after just over a year.

In the meantime, AMD and the Adaptive Sync consortium have moved along, and just about every new monitor now ships with FreeSync/Adaptive Sync support. The scalers are also far lower power than the FPGA Nvidia's upgraded G-Sync displays had to use, which means fans aren't normally required. Not all these displays work properly with VRR enabled, however, and it's ironically Nvidia's G-Sync Compatible program that often helps sift through the cruft. Pick a display that's G-Sync Compatible, and you'll know Nvidia has tested it to work with its GPUs, so it will likely also work with AMD GPUs.

This is all we wanted: someone to test monitors and ensure they function as intended. That should have been VESA, but it was a bit late to the party. There's now a VESA VRR certification (as of 2022) that sits alongside the AMD and Nvidia certs, which is supposed to indicate that a monitor passed the required Adaptive Sync tests. While the original VRR solutions were only for DisplayPort connections, HDMI 2.0b and later became a bit of a wild west, making it difficult to know for sure whether VRR would work properly or not.

The good news is things are settling down. Nvidia has taken its foot of the display connectivity gas pedal, topping out at HDMI 2.1 (42 Gbps data) and DisplayPort 1.4a (25.6 Gbps data), while AMD is shipping DisplayPort 2.1 compliant GPUs with up to 52.2 Gbps of data bandwidth. Monitors with DP2.1 are available, but even DP1.4a can drive up to 4K at 240Hz using Display Stream Compression. That's what Samsung's Odyssey Neo G8 line uses, and it works on AMD and Nvidia GPUs, with either HDMI or DisplayPort.

Sometimes, choice is good, but when it comes to standards, proprietary solutions don't normally stand the test of time. It's unfortunate that we have a bunch of monitors that mostly had to opt for being either G-Sync or FreeSync, but moving forward, we should hopefully end up with options that work with both AMD and Nvidia VRR technology. Now, what's the chance of that happening for ray tracing solutions? ■

Jarrod has been described as an AI by people he meets at parties.

Intel's next generation Battlemage graphics cards will benefit all gamers

It'll keep Nvidia and AMD honest.

In case you hadn't noticed, graphics cards are expensive. Apart from voting with your wallet or purse, what can be done about it? Nvidia and AMD aren't charities. Their prices are high because they can get away with it. In the corporate world, altruism doesn't extend far beyond the coffers of shareholders.

The best hope for a reset of the gaming graphics card market is if Intel's second-generation Battlemage architecture is a roaring success. Even if you never buy an Arc card, a competitive Intel will benefit all gamers. I'd love to see Nvidia and AMD get a kick up the butt. Not for any nefarious reason, but because it'll force them to do more to fight for market share and be more competitive on price.

Battlemage is expected to launch some time in 2024. After the development of its first-generation Alchemist family, Intel has surely identified its architectural bottlenecks, and to put it simply, the low hanging fruit it can pick to deliver a big step forward.

"It would take something special to be competitive with AMD's - and particularly Nvidia's high end offerings"

It would take something special to be competitive with AMD's - and particularly Nvidia's high end offerings – but aside from the positive attention and 'gaming crown' headlines that a halo product brings, the high end is not that relevant to the overall gaming market. Most buyers will never even consider a high-end card. It's the RTX 4060s and RX 7600s of the world that generate volume sales, though their profit margins are not as big.

Nvidia enjoys a dominant market position, so it's a justifiable target of some criticism. Intel and AMD would do exactly the same if they enjoyed such dominance (the CPU market is another story). In 2008, Nvidia's GTX 280 and GTX 260 launched at $649 and $399 USD respectively. A week or so later, AMD launched the $299 HD 4870. The HD 4870 performed better than expected, and it forced Nvidia to react with price drops from $649 to $499 for the GTX 280 and $399 to $299 for the GTX 260. That's what healthy competition does, and that's what we should all be hoping to see a repeat of in the future.

Nvidia copped criticism for repositioning its RTX 40-series GPUs one tier higher than they were last generation. Its entry-mid range AD107 GPU – a GPU that would historically be built into the RTX 4050- is found in the RTX 4060. It did that because it's a small and cheap GPU with acceptable levels of performance. The fact that it has 8GB of VRAM with a 128-bit bus is not exactly thrilling either. The RTX 4060 delivers enough to beat the RTX 3060 with a higher profit margin than Nvidia would get if the faster AD106 was used instead. A competitive Battlemage card would force Nvidia (and AMD) to do better with its next generation mid-range offerings and/or lower its prices. That's as good a reason as any for all gamers to root for Battlemage's success.

Even if you are a diehard Nvidia or AMD fan, you should be rooting for Battlemage. A competitive Intel means Nvidia and AMD cannot set whatever prices they like. If Battlemage and RDNA 4 are competitive with Nvidia's Blackwell, you'll still get the same Blackwell card, but for less money than would be the case without the added competition, whether we buy them or not. Intel: Please make Battlemage good! ■

Chris Szewczyk has been elbow deep in PCs since before the turn of the millennium, and he wouldn't have it any other way.

A genuine x86 killer?

Arm's time has finally come on the PC.

Arm versus x86 is a battle for the ages, but the idea of PCs powered by Arm processors is a notion that's always just over the horizon. Just as commercially viable nuclear fusion is always 30 years away, Arm's assimilation looms large, but never happens – until now. In the last few months, it's become clear that Arm might be ready to take over the PC.

The tipping point, when we look back years from now from our brain-embedded Arm PCs, will likely be 2024. That's the year that Qualcomm's exclusive deal with Microsoft to provide chips with the Arm-compatible version of Windows expires and we see just what the market is capable of.

Qualcomm will be first out of the gate with a CPU for Windows on Arm. After years of lazy chip designs using off-the-shelf cores provided by Arm itself, Qualcomm has cooked up a radical new processor with cores designed in-house. Strictly speaking, the Oryon cores inside Qualcomm's new Snapdragon X Elite chip were designed by a startup known as Nuvia, populated by the same ex-Apple engineers who helped make its silicon the most powerful Arm-based hardware you can buy in consumer computing devices today.

"The tipping point, when we look back years from now from our brain-embedded Arm PCs, will likely be 2024."

Qualcomm bought Nuvia in 2021, and the recent unveiling of the Snapdragon X Elite was the culmination of this. It's not clear when the first devices with the chip will appear, but we know it's designed to be a high-performance CPU for laptop PCs, and that Qualcomm is making big claims.

First, Qualcomm claims it offers over 10 percent better single-thread performance than any Apple M2 chip, on par with or possibly just behind Apple's new M3 silicon. At the same time, Qualcomm says it can match M2's single-thread performance on 30 percent less power. As for the x86, Qualcomm reckons Snapdragon X Elite has the edge on Intel's top Core i9-13980HX CPU for single-threaded performance, and can match it while consuming 70 percent less power.

The multi-thread comparison is more complicated, given that there are x86 and Apple chips with numerous core counts. But with 12 cores, each claimed to have industry-leading performance, the Snapdragon X Elite will be no slouch. Next year, you'll be able to choose between the x86, Apple MacBooks, and Qualcomm Snapdragon X Elite-powered laptops.

Thanks to the expiration of Qualcomm's exclusive Windows deal, you will see further options in the Arm-powered laptop PC market. Both AMD and Nvidia are working on their own Arm processors for Windows PCs. At the same time, Microsoft has improved the emulation layer in Windows for Arm, which allows legacy x86 software to run on these new chips. Six months from now, you could buy an Arm-powered Windows laptop that runs the majority of existing Windows code as well as a native x86 machine.

The application that Arm platforms will find hardest to crack is gaming. Even the slightest deficiency in emulation will be obvious when it comes to in-game frame rates. It's also a very big ask for developers to compile and optimise games for both x86 and Arm.

The final piece of this puzzle is the recent tranche of leaked documents from Microsoft revealing that Arm CPU cores are being considered for the next-generation Xbox console. If that happens, x86 chips in consumer PCs could be on borrowed time. ■

Jeremy has a black leather jacket just like Jensen's.

Lego lessons

Jon Honeyball harks back to the old days when things made sense.

I only got into Lego a few years ago. I never grew up on it, with my fascinations covered by understanding how computers and networks worked. Sometimes this was incredibly frustrating – anyone who wrote programs for Windows 2 using the software development kit and the C compiler will remember the masochistic pleasure of writing your own WinMain() handler to dispatch windows messages around the various apps that were running. Then came the GUI programming languages from Borland, and Microsoft's own Visual Basic. Suddenly the building block approach to creating solutions made sense.

In recent years, however, computing has somewhat gone off the rails. The tools really haven't kept up with the needs of those who want to dabble, despite the best efforts of Microsoft. And Apple with its toolsets for macOS, iOS and the rest. I have built bits and pieces, but there has never been the sense of completion that we had back then.

"Computing has somewhat gone off the rails. The tools really haven't kept up with the needs of those who want to dabble, despite the best efforts of Microsoft."

Perhaps this has fed my love for the little plastic bricks. Taking many thousands of bricks, pegs, connecting rods and so forth, and following precise step-by-step instructions to create something tangible and three dimensional, has its own unique pleasure. If only I could find the same satisfaction from modern-day computing. 2023 was the year when LLMs and ChatGPT came to the fore. Some of this AI work is astonishing. LLMs and ChatGPT tools can create almost convincing wordage at a speed that boggles the mind.

But the world of AI is rapidly falling into chaos. Take a handful of days in mid-November. First came the resignation of Ed Newton-Rex, the lead of the audio team at Stability AI. His long tweet detailed his concerns with the widely held belief that "fair use" in copyright terms applies to such AI generated works. He maintains that it doesn't, because the resultant audio (or video or picture) can directly compete with the original material which was used to train the models. And he was sufficiently concerned about this to resign his position.

A couple of days later, Sam Altman was fired from OpenAI, with Greg Brockman, president and co-founder, resigning soon after in protest. Immediately afterwards it was announced that OpenAI's co-founders would lead an all-new AI research team at Microsoft, with many disgruntled OpenAI employees expected to follow suit.

This is a wise defensive move – Microsoft doesn't want Altman and Brockman to head to rivals, after all – but at the same time Microsoft must play nice with OpenAI and its new leadership team. This is important, because Microsoft owns a whole chunk of OpenAI, and it is critical to its rapid deployment of a world of Copilot technologies across the whole Microsoft estate.

But here is the problem. This is a huge rush into the unknown, and even the biggest players in this space are moving around at a rate which is of concern. Who knows what will happen by the time you read this, let alone where this story will lead next year? Meanwhile, I can just hark back to the earlier, easier and more understandable days of computing.

Much like my time with Lego, I know what it does, I can see how it is supposed to go together, and I value the time I spend with it because it takes me away from the day-to-day complexity and confusion of the modern world. I need less noise like Bitcoin, blockchain, ChatGPT and LLMs in my life, not more. ■

Jon Honeyball is happiest when not standing on a Lego brick by mistake.

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FUTURES

We explore the trends and technologies that are set to shape the future

Facial recognition for bears

And other ways to use the technology for good. Researchers have paired a neural network and a facial detection system used in a "dog hipsterisation" app to help manage and protect grizzly bears. Nicole Kobie reveals how BearID was created.

Facial recognition is problematic for humans. When it works, it invades privacy and eases us into a surveillance state. When it doesn't work, people have been falsely arrested by police. But that's people. For bears, it's all good – and facial recognition is now being used to help research, monitor and protect the animals using a neural network-based system called BearID.

Melanie Clapham tracks grizzlies. Normally, that requires methodically examining photographs or physically tagging the animal, as the University of Victoria researcher's work on grizzly behaviour requires being able to pinpoint a specific individual.

But that's not easy because bears have few distinctive markings – they're all brown and fluffy – and can dramatically change appearance from one season to the next. "They moult their coats in the summertime," said Clapham. "And in the autumn, before they go into hibernation, they can put on a third of their body weight."

If individual bears are watched closely, it's possible to track them through such changes. However, that becomes more difficult when you're monitoring many bears over a wide area or not seeing the same bear frequently enough. "If you're not observing them constantly, it can be difficult to pick out the same bears even between spring and fall," she said.

Wild solution

Clapham knew there had to be a solution, and realised that automation and machine learning could be part of it. To find out, she joined a group called Wildlabs.

Based in Cambridge, Wildlabs is a network of 4,305 members including field conservationists, researchers and technology experts. "Academics often have really specific research questions they're answering, and a high level of expertise and time to build their own stuff," explained Stephanie O'Donnell, community manager at Wildlabs.

Wildlabs was founded by NGOs, including the WWF, and tech groups such as Google.org and Arm in the hopes of bridging the gap between the two worlds. "Conservationists who work in the field find it really hard to find other conservationists to talk about technology," O'Donnell said. "Field conservationists are trying to manage big protected areas or monitor a whole ecosystem while dealing with challenges around human-wildlife conflict or climate change. They need technology to do different things."

The BearID project was a bit of both, taking in practical management with academic research. O'Donnell recalls Clapham getting in touch because two hours earlier she heard from Ed Miller and Mary Nguyen, a pair of Silicon Valley software developers who were working on a similar idea as part of a bear-watching project called Explore.org, which has webcams watching grizzlies at Brooks Falls in Katmai National Park, Alaska. "I was like, 'you guys must be working together already'," said O'Donnell. But they weren't, so she helped link them up. "That interaction is exactly what Wildlabs was created to do."

Brought together by Wildlabs, the two projects combined their resources and

Melanie Clapham

Getting tech right with Wildlabs

Wildlabs is always looking for technology experts – and that includes you, *APC* readers. The challenge faced by conservationists is figuring out what tech is actually useful to their work, which isn't always easy to unpick when marketing companies descend on a project. "How do you know if this technology is something I should be looking at," said O'Donnell, "or is someone just selling a shiny object that won't actually do anything for my project?"

She points to drones as an example of hype in conservation tech. "Drones have definitely gone through a peak of inflated expectations, and then the trough of disillusionment," O'Donnell said. "And now we're coming out and finding specific use cases where drones are really useful for conservation."

If you want to get involved in tech support for conservation, it will require a bit of commitment. Conservationists have been working on projects for years, and need long-term help. O'Donnell points to one-off support from the tech industry such as hackathons, calling such short-term, PR-motivated offers to help "silicon seagulling", where they come in, drop off some tech and then disappear. "It's really easy to run a one-off event like a hackathon," O'Donnell added. "But prototypes don't help us, we need someone who can commit for three years… so it becomes something conservationists can actually use."

Instead, Wildlabs is looking for technologists with specific expertise and a passion for conservation, who are willing to invest time into building relationships with academics and field workers. The best way to get started, said O'Donnell, is to register on the website, sign up for the newsletter and start attending virtual events that appeal to you. That's the best way to find out what sort of projects are looking for help and get to know the rest of the community. For example, at least once a week there's a tech tutorial.

The most recent one had a panel discussion with remote camera tracking projects in the Canadian north, including an elder from a local community, a trapper and a research scientist. "We hear from tech people that it's really hard to find conservation projects that can use their help, and this is the best way to connect into that community around the world," she said.

O'Donnell adds that Wildlabs is a welcoming place and an open community. "It's the place to discover this world of conservation," she said. To find out more, head to **wildlabs.net**.

their datasets to set up BearID, and, over several years, developed software that would analyse images to learn how to recognise one grizzly from another.

Building BearID

The system itself is designed in two sections. First, there's a facial-detection tool, which looks at the image, recognises a bear's face, and makes measurements between key aspects, such as eyes and the tip of the nose. Rather than design such a program from scratch, the team used a pre-made system from Dlib, a library of machine-learning algorithms and tools, that was designed to recognise dog faces in order to give them hipster glasses and moustaches – yes, you read that correctly. Silly apps like the "dog hipsteriser" aren't necessarily a waste of time in the right hands.

"We used elements of that network to help us detect bear faces initially, which gave us a bit of a kickstart, though we did go back and retrain it on bear faces," Clapham said. That made the job of labelling bears faces easier, plus it let the team add hipster glasses and moustaches to bears, which is as delightful as it sounds.

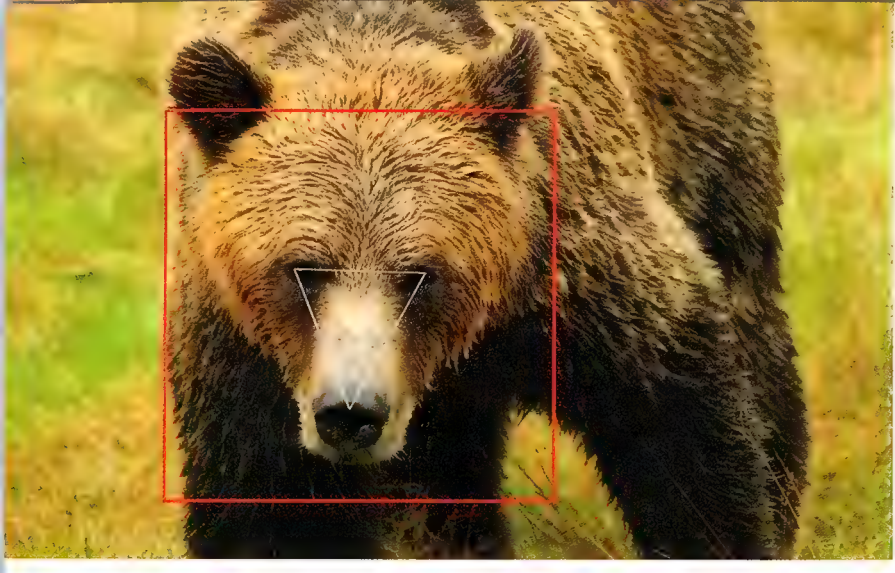
The other half of the system is facial recognition. That began with labelling the photos, marking each bear, in order to use that data to train a machine-learning system. Human facial-recognition systems are taught on millions of images, but there simply aren't enough bears for such detailed training.

The network is shown a selection of images that have been correctly labelled to learn how to tell bears apart. "We don't tell the network what to look for in a bear's face, we just present the labelled data," said Clapham. "Over time, the network learns what is stable about that bear's face and uses that to distinguish between different individuals."

The first version of the system was trained on 5,000 images of 132 bears, half from Alaska and half from further south in the US and Canada. That was split into two sections: 80% were used for training and 20% to test the system's accuracy. When a bear's face is detected, a deep-convolutional neural network examines 128 dimensions on the image.

But even at this early stage, the system works. Across the two sites, at Knight Inlet in British Columbia and Brooks River in Alaska, the BearID system could identify animals with 84% accuracy. While

BELOW The facial recognition measures characteristic parts of the bears' faces… with the purely academic bonus of transforming them into adorable hipsters.



LEFT Other data such as bear size may be taken into account to improve accuracy.

we don't know exactly what the deep-learning network is doing to differentiate bears, it intriguingly struggled on the same animals that Clapham had difficulty telling apart. In the future, additional data such as geography and animal size may also be considered by the system to improve its accuracy.

What's next?

So far, the system has only been used on existing photos of bears, those that have been taken with handheld cameras. The next stage of the project is to use the automated system to identify and label bears spotted via remote camera traps, which may require more training for the network as the perspective and angles differ.

"That's where this technology will become very useful for research and monitoring of grizzly bears, and hopefully other species too," explained Clapham.

Another future goal is having the system track newly spotted individuals. At the moment, the network needs to be trained on each and every bear, with new animals added manually. "We really need to be able to distinguish between individuals that it's already seen and those that it hasn't seen yet," she said. "That will probably take some retraining. This is really the first step."

Working solution

This automated bear-spotting system could change research around the furry beasts. Once it works with camera traps, it can help count bears for population measuring. "To be able to do that, you need to be able to recognise individuals, because you capture and recapture the same bears over time," Clapham said. Such data is important for managing species that are facing a decline, and is currently done using genetic tagging, which is much more time consuming and difficult.

Clapham is most excited about using the automated system for studying their behaviour, which is the focus of her own research. BearID can help track individual bears across landscapes, helping to study their movement in response to food availability and human development. "We're interested to see how this could be used to reduce conflicts between people and bears," she said. And, she explains, it can hopefully be extended to other types of bears, letting researchers and conservationists track any species.

In the end, facial recognition may be problematic for people, but, with ideas such as BearID, it could prove a lifeline for grizzly bears. ■

Tracking animals with facial recognition

BearID isn't the first conservation project to track wildlife using facial recognition – and, given its success, it won't be the last. Here are three other projects that are turning the controversial tech into a tool to protect nature.

CHIMPANZEES

Researchers at the University of Oxford and Kyoto University trained facial-recognition AI to identify chimpanzees in Guinea, West Africa, using 50 hours of footage of 23 primates. The system was accurate 92% of the time, but to further test the system, the team used it on 100 still images that were also given to human researchers. In that trial, the facial recognition took 30 seconds to accurately identify the chimpanzees 84% of the time versus the humans who only managed a 42% success rate – and took 55 minutes to lose that badly. It's hoped that the system will work on other primates and help researchers understand how social networks change in groups of the animals. The researchers followed up the facial-recognition system with a neural network that can identify animals from their body alone, helpful for when the primates turn their backs on the camera.

LIONS

Kenyan conservation group Lion Guardians has developed a database of feline images to track specific individuals. Dubbed LINC – or Lion Identification Network of Collaborators – the project captures photographs of the big cats and analyses them with facial recognition to track their movements. While that's much easier than sedating a lion and fitting it with a GPS transmitter, the photos still have to be taken from within 100ft. LINC looks at two areas of a lion's face to identify it: its whisker patterns and its facial features. The data is helpful to a variety of wildlife groups, as lions have a massive range, travelling across borders and through different conservation areas. Find out more at **linclion.org**.

SALMON

Monitoring endangered species via facial recognition makes sense, but Norwegian fisheries giant Cermaq is trialling a similar idea to watch over the health of salmon on its farms. The BioSort system separates each and every fish of 150,000 in a farm into a chamber when they come up to the surface, where a 3D sensor scans its face for unique markings. The aim is to improve the health of fish, so if the camera also spots diseases such as sea lice, the specific fish will be quarantined for treatment. The aim is to reduce unnecessary handling of fish, which Cermaq says can cause stress for the animals. Find out more at **cermaq.com**.

Top photo Melanie Clapham

NEW POWER

ENTER THE ATX 3.0 ERA

PURE POWER 12 M

DEVELOPED IN GERMANY

Pure Power 12 M is be quiet!'s entry in the ATX 3.0 era. The Pure Power 12 M is ATX 3.0 compliant, PCIe 5.0 compatible and offers peerless dependability with best-in-class features. Having both a PCIe 5.0 12VHPWR cable and up to 4 PCIe 6+2 cables in the scope of delivery, this PSU offers outstanding compatibility with current-gen and next-gen graphics cards. Pure Power 12 M offers the best combination of features in its class. It is available with: 1000W, 850W, 750W, 650W and 550W.

- 80 PLUS® Gold efficiency (up to 93.2%)
- ATX 3.0 PSU with full support for PCIe 5.0 GPUs and GPUs with 6+2 pin connectors
- Exceptionally silent 120mm be quiet! fan
- Handles massive power excursions
- 10-year manufacturer's warranty

be quiet!®

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The A-List

The best products on the market, as picked by our editors.

Premium laptops

Apple MacBook Pro 16in (M3)

STUNNING CREATIVE POWER

A reasonable processor upgrade to device with an impressive screen and unparalleled battery life. The new M3 3nm processors is more efficient, so you'll be able to run the same tasks as the M1 using half the power draw, which helps battery life.

From $4,299, apple.com/au

THE ALTERNATIVES

ASUS VIVOBOOK PRO 16X OLED
This 2023 update has some impressive features for the price and is a surprisingly powerful creative workstation with a stunning screen.
$3,199, asus.com

APPLE MACBOOK AIR
The MacBook Air M2 looks like a standout to us. A powerful and quiet ultraportable with an unbeatable battery life and a great pro display.
From $1,799
apple.com/au

MICROSOFT SURFACE PRO 9
APC rates the Intel model highly, the SQ3 model less so. With Intel, you get a solid upgrade to the world's leading detachable tablet laptop.
$1,547
microsoft.com

Business laptops

Lenovo ThinkPad X1 Carbon Gen 11

BUSINESS CLASS

Fight past Lenovo's opaque pricing – another flash sale, really? – and you'll find a slim, powerful and long-lasting laptop for a competitive price. With a wide range of available configurations, all based on Intel's 13th generation Core chips, this is our top choice for all sizes of business.

From $2,086, lenovo.com

THE ALTERNATIVES

DELL LATITUDE 7340
This 1.1kg laptop offers terrific battery life and, if you choose the better non-touchscreen (look for 400 nits of brightness in the specs).
$2,475
lenovo.com/au

ACER TRAVELMATE P6
Not the most powerful due its 11th gen Core chip, but a great 14in screen and keyboard, superb battery life and competitive price lift it above rivals.
$2,179
acer.com

NEW HP DRAGONFLY G4
It's not the fastest machine you can buy, but otherwise this 1kg masterpiece is as close as you're going to get to the perfect business laptop for executives.
From $2,950
hp.com

Gaming laptops

Razer Blade 15 (2022)

A SUPERBLY ENGINEERED GAMING POWERHOUSE

Right now there's just not another better value gaming unit around. It's miraculously thin considering the beefy components inside, thermals are very well managed and the Razer Blade 15 manages to extract very good performance from its GPU without undue throttling. There are many variants and options, and they're an outstanding buy if you find one on sale.**~$2,999, razer.com/au-en**

THE ALTERNATIVES

LENOVO LEGION 5I PRO (16IN)
A great-value gaming laptop that's extracts the most from its powerful components. We really love the keyboard, too.
$3,899
lenovo.com/au

RAZER BLADE 18
A great advert for 18in gaming laptops, the Blade 18 partners a Core i9-13950HX with RTX 40-series graphics in a stunning, slim design.
$5,399,
razer.com/au-en

ASUS ROG STRIX SCAR 18
It's expensive, but if you want an 18in laptop that delivers all-out power this is the no-compromise 3.1kg beast to buy – it packs quality everywhere.
From $4,599
asus.com/au

Everyday laptops

Asus Zenbook S 13 OLED

ASUS AND INTEL TEAMED UP TO BUILD A MACBOOK AIR KILLER

A compact and budget friendly Ultrabook that's the best available device for many on-the-go professionals. Compared to the MacBook Air 13, it has an additional HDMI and USB-A port, an SSD that's roughly twice as fast, and the screen is brighter and offers rich OLED contrast.

$2,099, au.store.asus.com

THE ALTERNATIVES

MICROSOFT SURFACE LAPTOP GO 2
Runs cool and quiet, and has up to 30 percent better battery life than its predeccessor, all in a beautifully designed form. **From $1,199, microsoft.com**

APPLE MACBOOK AIR 15
An awesome plus-size MacBook Air with great battery life and graphical performance. GPU performance and battery life are the standout perks here. **From $2,199, apple.com/au**

HP PAVILION 14
This slim 1.4kg laptop is a superb choice for anyone on a tighter budget. it struck an excellent balance between speed and battery life – around ten hours. **From $949, store.hp.com**

Chromebooks

Asus Chromebook Flip CX5

The best big-screen Chromebook we've tried, with a bright 15.6in Full HD display with decent black levels and surprisingly rich colours. And it's a good specification for the price, with a Core i5 processor, 8GB of RAM and a 256GB SSD in tow. **$1,179, asus.com/au**

Lenovo Flex 3i Chromebook

This isn't the most powerful Chromebook, but students need reliability more than power – especially if they're only really using it for homework, note-taking, and perhaps the occasional bit of Netflix.
$367, lenovo.com/au

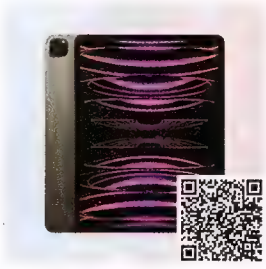
Lenovo IdeaPad Duet

The Chromebook answer to Microsoft's Surface tablets, this is a seriously versatile device – albeit not the speediest (although we never found it to be painfully slow while carrying out everyday tasks). For this price, and with a 16hrs 14mins battery life, the Duet is a great choice.
$297, lenovo.com/au

Tablets

Apple iPad Pro 12.9in

Blurring the boundaries between laptop and tablet like never before, the M2-powered iPad Pro 12.9-inch is every bit as fast as we expected – and the Liquid Retina XDR display is simply phenomenal.
From $1,899, apple.com/au



Google Pixel Tablet

A powerful and vibrant tablet that works seamlessly as a Google Home Hub. Google's first local tablet is an awesome addition to your smart home, and its lower price point doesn't hold it back from competing with the best.
From $899, store.googlecom/au

Samsung Galaxy Tab S9 Ultra

This 14.5in tablet offers a size and versatility that even the iPad Pro can't match, with its high price more than justified by the quality of Samsung's AMOLED panel, speakers and productivity software.
$1,999, samsung.com

Everyday monitors

MSI MEG 342C QD-OLED

Quantum Dot technology combines with an OLED self-emitting panel to offer brighter, more efficient and more colourful visuals than your average OLED screen.
$1,799, msi.com

Eizo FlexScan EV2480

Businesses in particular will love this easy-to-roll-out 24-inch monitor, with its exceptional five-year warranty, USB-C port for easy docking, excellent viewing angles and delicious whites. And it has the best OSD around.
$619, eizoglobal.com

Dell S2721DS

The Dell S2721DS is a solid and affordable QHD monitor that'll suit general users and casual gamers alike. It boasts a gorgeous 27-inch 1440p display, a 75Hz refresh rate, and a vivid IPS panel that hits 99 percent of the sRGB color gamut.
$319, dell.com.au

Professional monitors

Eizo ColorEdge CG319X

As the price indicates, this monitor is for heavyweight creatives who demand the best in every discipline: HDR video editing, print layouts, professional photography and more besides. With superb coverage and accuracy across all spaces, plus a built-in calibrator, it justifies the investment.
$5,995, eizoglobal.com

BenQ PD2725U

By no means a cheap 4K 27-inch monitor – unless you compare it to the Eizo – but it marries all-round quality with ease of use thanks to a puck that allows you to quickly move between settings. You can even daisy chain a second Thunderbolt 3 monitor for a monster setup.
$1,399, benq.com

Asus ProArt PA279CRV

Asus's new 4K productivity panel delivers near pro-levels of performance and precision, though its HDR capability is inevitably limited. What you get is Asus's usual high levels of build quality, plus extras, including essential HDR support and a stand that includes rotation into portrait mode. $799, **asus.com**

Home office printers

Epson EcoTank ET-1810

There's nothing flashy about this bottle- fed inkjet: it's there to churn out pages at a decent rate (8.8ppm for black text) for a low price. It comes with enough ink for 4,500 black pages and 7,500 in colour, but refills are cheap. Just don't expect features like duplex printing.
$249, epson.com.au

Canon Pixma Pro-200

Yes, it's big and it's expensive – and you don't even get a scanner – but the Pixma Pro-200 means that you can print A3 photos with glorious colour accuracy and detail. If you're after an office workhorse, look elsewhere, but it can't be beaten on photo quality.
$719, canon.com

Brother MFC-J4540DW

Home workers will love this inkjet all-in-one. It combines an incredible range of features with all the connectivity you need and extreme ease of use. Output quality is fine, it offers the best cloud support around and the high-capacity ink pack could keep you going for years.
$329, brother.com

Find the best deals on new gear at **getprice.com/au**

Wireless routers

Synology WRX560
Its quad-band Wi-Fi smashed-through our performance tests managing 791.5Mbps up close, 375Mbps two rooms away and an amazing 216.7Mbps down the garden.
$419, synology.com/au

Asus ROG Rapture GT-AX16000
The most splendid, overpowered router on the market. But, it's silly money and aspirational to most users. Ultimately, though, it's currently the highest-spec consumer router available.
$999, asus.com/au

Asus TUF Gaming TUF-AX4200
Ultimately, this is one of the very best featured and fastest routers we've ever tested and, at $320, it's a steal. It's affordable, fast and dripping with features. Only power users might want more performance headroom.
$319, asus.com/au

Mesh Wi-fi

TP-Link Deco XE200
There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack should be enough for most premises.
$1,299 (2-pack), tp-ink.com

TP-Link Deco X20
The Deco X20 makes it possible to upgrade your home network to Wi-Fi 6 for the price of some standalone routers. The HomeCare functions are also a great bonus for households where lots of devices are fighting over the bandwidth. **$227 (2-pack), tp-link.com**

Asus ZenWiFi AX
The interface and design certainly aren't the prettiest (the charcoal version is straight out of the 1980s), but if you're after strong performance, great features and plenty of expansion potential, the ZenWiFi AX is a compelling prospect.
$939 (2-pack), asus.com/au

NAS servers

QNAP TS-130
An above average CPU and RAM combo, solid features and affordable price make the QNAP TS-130 worth considering. Alternatively there's the two bay TS230 which features the same CPU, with 2GB of RAM, dual drive bays, and an extra USB port on the front for a modest ~$50 price increase. **$199, qnap.com**

Asustor Nimbustor AS5304T
This is a hugely powerful four-bay NAS that will be overkill for most people – not just due to its speed but also its slightly intimidating user interface – but techies and gamers should investigate the Nimbustor AS5304T for both its speed and flexibility.**$679, asustor.com**

Synology DiskStation DS1522+
At $1,199 it's not cheap but factoring in the software means it's great value. Though some internal silicon may lack headroom, this is still a well-featured, expandable NAS with fantastic software. The best part is the DSM software.
$1,199, synology.com

Security software

G Data Total Security
A suite for power users with a host of useful features that offers formidable protection against viruses.
US$49.95, 1 device, gdatasoftware.com

THE ALTERNATIVES

AVAST ONE ESSENTIAL
The only product in our tests to score a 100% protection rating for blocking all malicious files, this reliable choice is our pick of the free AV tools and includes a free if limited VPN service.
Free, avast.com

MCAFEE+ ADVANCED
A high-end choice with high-end features and support for an unlimited number of devices. Good value for the first year, but watch out for renewals.
$139.95, individual, unlimited devices, mcafee.com/en-au

NordVPN
NordVPN provides consistent and fast speeds, serious security, great support for video-streaming services and some cost-effective subscription rates.
$59 per year, nordvpn.com

THE ALTERNATIVES

PROTONVPN
ProtonVPN provided one of the best free offerings of all the VPNs in our group test, including unlimited data, but upgrade to benefit from even faster speeds and many more options.
Free, protonvpn.com

SURFSHARK
A strong rival to NordVPN, especially if you're willing to commit to its two-year contract. It's fast, cheap and a fine choice for people who like to switch to US streaming services.
$79.61 for one year, surfshark.com

Bitwarden
Bitwarden has a huge advantage: it's free. It isn't as slick as some paid-for rivals, but it can sync passwords across all devices for no extra charge. **Free, bitwarden.com**

THE ALTERNATIVES

DASHLANE
A manager that's ideal for beginners, and it even builds in an unlimited (if basic) VPN service. Note you may prefer to buy the Family plan ($60 per year) as this extends the service to six people.
$55.99 per year (Premium), dashlane.com

1PASSWORD
1Password is targeted at users who are looking for the last word in security. It even offers a Travel Mode that may ease your mind if surrendering your phone to customs officials. **$54.99 per year (individual), 1password.com**

THE LIST

The best handheld gaming PC in 2023

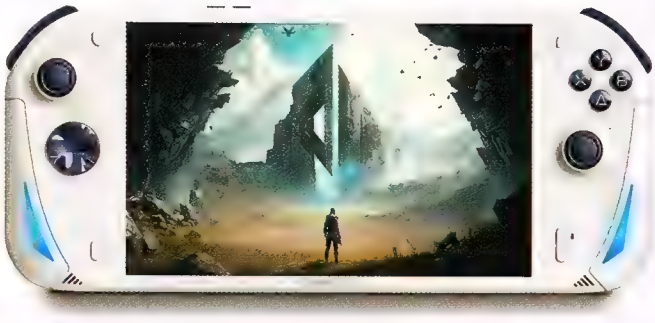
Until very recently, the handheld gaming PC market was essentially just the Steam Deck, with not enough contenders to round out a Top 5 list. Now, they're coming from all corners, and it's not hard to understand why. The ability to play your favourite PC games wherever you are clearly appeals to a lot of buyers, but how do you make sure you get the best bang for your buck? By buying one of our picks below, of course.

5 AYANEO AIR 1S

Go for the Ayaneo Air 1S because it's incredibly portable, coming in at just 21.6mm thick and weighing only 450g. You needn't worry about its inclusion in your luggage if you're traveling long distances. Its size isn't at the cost of power, thanks to the beefy AMD Ryzen 7 7840U chip found in the other top-end models on this list.

www.ayaneo.com, $1,449

> "Go for the Ayaneo Air 1S because it's incredibly portable, coming in at just 21.6mm thick and weighing only 450g."



4 AOKZOE A1 PRO

The killer feature on this gaming handheld? That 8-inch 1,920 x 1,200 display that makes PC games that would be otherwise barely playable on a small screen eminently enjoyable. The downside is that it isn't cheap, and pushes the product into gaming laptop-level prices. If money's no object though, the A1 Pro is the one on this list we find ourselves coming back to the most.

www.aokzoestore.com, $1,638

3 STEAM DECK

With the new Steam Deck OLED landing, the older LCD model has received a discount. If you bear in mind that the Switch costs $400, the Steam Deck looks like a bargain. The processor lags behind the others on this list, but it'll play most AAA games.

www.steampowered.com, $759 (64GB)

2 ONEXPLAYER ONEXFLY

The most well rounded option of the bunch, thanks to a lighter and smaller body. AMD's latest 7840U APU has a lovely 120Hz display, great longevity thanks to a 48Wh battery and power management options, and fast LPDDR5X-7500 memory. It's a sleek all-rounder.

onexplayerstore.com, $1,525

1 STEAM DECK OLED

In with a bullet even before we've properly reviewed it is Valve's first revision to its handheld gaming PC. It's not be the most powerful model, so don't expect to be able to crank up the settings on newer games like *Starfield*, but this is still the best option for most, thanks to its keen price, ease of use, and that stunning OLED screen. It's the best portable console screen ever made.

www.steampowered.com, $1,299 (512GB)

> "Still the best option for most, thanks to its keen price, ease of use, and that stunning OLED screen."

GADGETS

The gear we're lusting after

Nikon Z f

From $3,499 | nikon.com.au

Inspired by the Nikon FM2 camera, the Z f is a full-frame mirrorless camera that blends analogue design with Nikon's acclaimed Z series performance. The 24.5MP camera boasts an Expeed 7 processor, 4K video (as well as 10-bit H.265), and eight-stop vibration-reduction image stabilisation. The processor enables subject detection so that the camera can automatically move its focus to follow the subject.

The Z f is Nikon's first full-frame Z camera with a fully rotatable touchscreen vari-angle monitor, and Touch FN means you can use your thumb to specify focus on the monitor while you compose your shot through the viewfinder. Thanks to Pixel Shift, you can blend up to 32 shots to create really high-res images, and there are Flat and Deep Tone Monochrome options as well as a dedicated B&W mode.

The Z f combines top camera tech with iconic design.

Bose QuietComfort Ultra Headphones

$445 | bose.com.au

Bose's new flagship headphones are intended to knock your socks off both in terms of audio output and noise cancelling. We're liking the tactile beauty of the headphones which, as the name suggests, makes them very comfortable for long periods, and the comfy cups seal well around the ears to aid isolation.

The headphones boast Bose's Immersive Audio Tech which is akin to Apple's Spatial Audio to ramp up your listening experience. The noise cancellation (aided by Bose's CustomTune calibration) is great, and switching to Motion mode effectively "allows the audio to move with you", with the intention of making it feel like you're not even listening through headphones.

ULTIMATE EARS EPICBOOM

$399 | ultimateears.com

Ultimate Ears really have nailed the 'portable Bluetooth speaker that packs a powerful punch' market. The EpicBoom offers two tailored modes to power up your listening – PartyUp mode for your indoor gatherings and Outdoor Boost for when you're doing your audio entertaining al fresco – and it has an impressive 55m connection range. It's IP67 rated so it can cope with a bit of a session at the beach too. You get 360° of immersive sound and adaptive or preset EQ, and a respectable 17 hours of playtime.

VIEUNITE TEXTURA

$TBA | vieunite.com

Digital art is not the same as real art. Well, yes, but Vieunite is aiming to narrow the divide. The Textura is a digital canvas that combines texture-accurate technology with an anti-glare finish to enable both art and photography to be shown to its full potential. The 27in canvas sits in a wooden surround to frame your artwork, and you can choose from pine, birch, walnut or black to match your décor. The Vieunite app even connects you to a community of artists and photographers, enabling you to change and update your collection as you go.

ENABOT EBO X

$1,575 | enabot.com

Come on, we're on the cusp of 2024. Surely, we should all have a household robot by now?! The autonomous EBO X is promoted as a 'smart guardian'. It boasts Alexa support, a 4K stabilised camera with colour night vision and a Harman AudioEFX speaker. The cute little helper smart maps your home and connects to Internet of Things (IoT) devices. The robot can recognise different family members, and there's fall detection and two-way communication, with the EBO Home app enabling you to connect to the EBO X and check in on loved ones.

NOTION | APPS Windows; macOS; Android; iOS, or any web browser. **PRICE** Free license for individual use; AI-powered features cost US$10/mo after set number of uses
TODOIST | APPS Windows; macOS; Linux (Ubuntu 20.04+); Android; iOS; Apple Watch, or any web browser. **PRICE** Free license for individual use; individual Pro account costs US$5/mo or US$48/yr.

Notion *vs* Todoist

Nick Peers examines which is best for staying on top of your projects?

With modern life refusing to slow down, it's now almost impossible to manage your life on paper, never mind in your own head. Juggling personal and professional projects, all with competing deadlines demanding you give them priority, requires third-party help, and there are a raft of cloud-based services offering to help everyone from individuals to corporations manage themselves better.

We've focused on two services that offer usable free tiers for individuals, and our remit was to see how they fared managing a single person's work and home lives. In one corner is Todoist, a tool with a narrow focus on helping you manage projects through simple to-do lists and deadline-based tasks, while in the other, Notion offers a wider range of productivity tools with project management just one part of a three-pronged approach that also includes space for research (wikis) and notes (documents).

Both tools can be accessed online through your browser, as well as through a variety of desktop and mobile apps. Todoist has the edge in app support, with Linux covered alongside the Apple Watch, as well as offering email plugins to make it possible to convert emails from supported mail clients (including Gmail) into to-do lists, complete with link back to the original email.

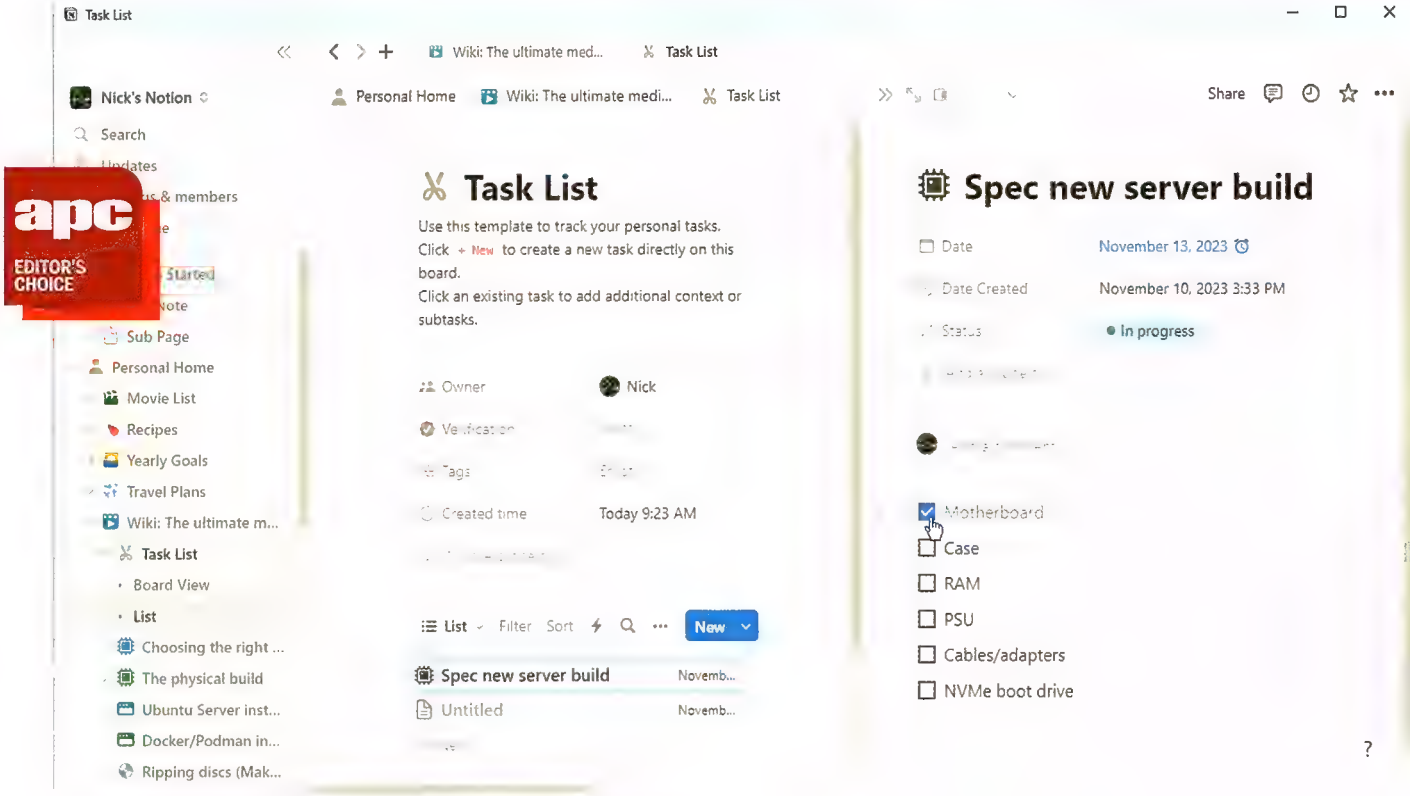
If simplicity is your aim, then Todoist is much easier to navigate and quicker to set up. You open to a simple two-pane view, with Inbox, Today, and Upcoming providing you with a range of views. Beneath this are Projects – of which you can manage up to five at a time on the free tier. Projects can be divided into Sections, inside which you can nest your lists.

Todoist keeps things simple by supporting one type of content only: a basic task that comprises a title, optional description, and check box. You can then add a deadline, assign a priority flag, attach labels, and – if you upgrade to a Pro account ($US5/mo, US$48/year) – set reminders and link the task to a location.

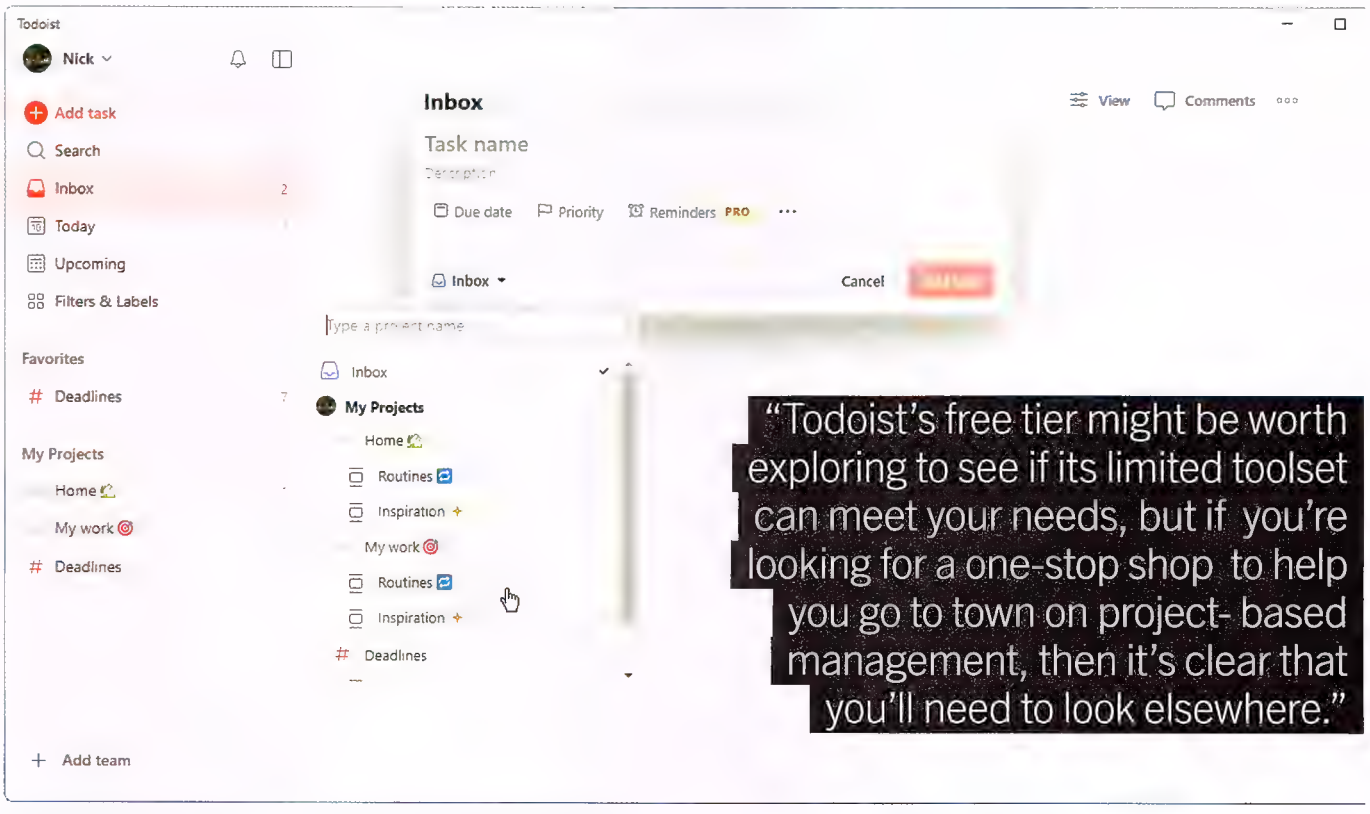
Tasks can be assigned sub-tasks that work in exactly like their parent, and then it's case of choosing where to file them – they can be left unassigned, in which case they'll float about in your inbox, or you can attach them to a single project.

Navigation is quick, and it doesn't take long to grasp pretty much everything Todoist can do. When browsing projects, you have a choice of viewing your tasks as a simple list, or switching to kanban board view, complete with options for both grouping and sorting your items by various criteria, such as date due or priority.

Sharing with others can be done through setting up a link to your cloud-based calendar, while there are options to set up shared workspaces to collaborate in groups, although you're limited to a single workspace on the free tier.



You can use Notion to record tasks and projects, but it's just the tip of the iceberg.



Todoist is incredibly simple to use and navigate, but also extremely narrow in focus.

Push the envelope

Todoist may be simple to use, but it's also quite limited – you can paste hyperlinks into task descriptions, but you can't attach files or notes that may be relevant to your projects. If you want greater control – albeit with a steeper learning curve – then Notion is probably a better bet.

Once signed up, Notion logs you into a two-paned window that'll superficially feels similar to Todoist, but the differences soon mount. Notion organises all your content into pages, which can contain sub-pages to create an organizational structure. Unlike Todoist's simple task-based lists, however, Notion's pages are far more flexible – they're like Wordpress pages in that they consist of multiple content blocks, of which there are dozens of different types to choose from, including headings, body text, to-do lists, code snippets, file attachments and more.

Pages are easy to put together – simply add a block, choose its type from the dropdown, and then fill it in (and if you're stumped, there's even an AI tool to quickly populate fields for you, although be warned, you'll eventually be asked to pay US$10/mo to continue using it after getting an unspecified number of 'complementary responses').

While Notion is perfectly happy to let you start from a blank canvas, it will provide some pre-populated pages for you to see just what can be done – you'll find clever use of structure allied with its flexible content-building blocks results in Notion providing you with everything from simple to-do lists to rival Todoist, to fully blown wikis, journals, and a host of personal-themed pages, like movie watchlists and recipes.

These can be adapted for your own use, but you can also create new pages from templates that span a wide range of content across personal, work, and education sectors, with both your professional (personal finance, career building) and personal (health and fitness) needs covered. There's even a Life Wiki option that attempts to cram everything into one space with a range of pages spanning writing, planning, and personal growth.

It's clear, then, that Notion beats Todoist hands down with the range of content it offers, but it's also the winner within Todoist's specialist field of task-based to-do lists. Notion's task-based pages naturally support due dates and progress labels, but they can also be customised with extra labels and other content. When it comes to viewing your task-based lists, Notion gives you a wider choice of views, with timelines, tables, and galleries additional options alongside the standard lists, kanban boards, and calendars. Better still, you can configure multiple views of a list, switching between them as required via tabs.

We suspect it's already obvious which task-based tool we prefer. If your needs are relatively basic, then Todoist's free tier might be worth exploring to see if its limited toolset can meet your needs, but if you're looking for a one-stop shop to help you go to town on project-based management, then it's clear that you'll need to look elsewhere. Instead, sign up for a free Notion account to discover how its blend of features, flexibility, and user-friendliness can bring order to your chaotic life, and maybe even bring some frustrated ambitions to fruition. ■

VERDICT

Notion Packed with features; Customisable yet easy to use; Generous free personal tier. Can feel cluttered at times; Navigation sometimes a little convoluted.

Todoist Simple to use; Straightforward navigation; Wide app support. Extremely narrow focus; Inflexible and lacking advanced options; Too many core options restricted to paid users.

REVIEWS

Expert reviews and recommendations to help you buy with confidence

THIS ISSUE

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APC is Australia's oldest consumer technology magazine – having been consistently in print for over forty years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, and beyond. We have two goals: to find the best modern tech and to help you make the most of it.

Independent reviews

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three attributes.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

Labs testing

APC strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance including storage read and write speeds, gaming and battery life.

APC TESTBED THE CURRENT APC TESTBED USED IN THE LABS FOR BENCHMARKING ALL COMPONENTS. THIS TESTBED IS UPDATED AS NEW AND RELEVANT TECHNOLOGY COMES ON STREAM.

CPU Intel Core i9 12900K **Motherboard** Asus Maximus Z690 Apex **Graphics Card** Nvidia GeForce RTX 4090 Founders Edition **RAM** 2x16GB G.Skill Trident Z5 DDR5-6000 **Power Supply** Corsair AX1000 **Storage** Seagate Firecuda 530 2TB **Case** Thermaltake Core P8 **Cooling** Cooler Master Flux PL360 AIO **Operating system** Windows 11 Pro 22H2

APC EDITOR'S CHOICE
When a product scores 4.5 out of 5, it carries the Editor's Choice Award. These are products that exceed expectations and deliver a quality experience up there with the very best.

APC HIGHLY RECOMMENDED
You will see this award if a reviewed product has scored four out of five stars. It means most people can expect satisfying performance from the product, and that we would use it ourselves.

PRICE From $2,199 **WEB** apple.com/au

Apple iMac (M3)

Apple's updated AIO is a fresh and formidable option for creatives with lighter office workflows.

SPECS Mac OS 14; 23.5-inch retina display at 4480 x 2520 pixel resolution; 500 nit, Display P3 colour; Apple M3 8-core CPU; Apple M3 10-core GPU; 24GB Unified Memory; 1TB SSD; Ethernet; Wi-Fi 6E; Bluetooth 5.3; 54.7 x 46.1 x 14.7cm; 4.48kg.

The colourful 24-inch iMac from Apple had a major update back in 2021, when the sleek all-in-one PC was fitted out with the first Apple silicone processors. So this 2023 refresh is a much more conservative upgrade that adds a bit of processing power and modern interface specs to an already exceptional all-in-one.

The new iMac features the same two or four port configurations as its predecessor, with the former starting at $2,199. This is a pretty compelling starting price when you consider you're getting a 23.5-inch Retina display with a 4.5K resolution, a powerful 8-core M3 CPU and all the peripherals needed to get up and running, included in that price.

If you look online for a 24 inch 4K screen with professional colour capabilities it'll cost at least $800, throw in a few hundred extra for a decent mouse and a keyboard with fingerprint reader and you're basically only paying $1,100 for the computing part of this all-in-one. For that you get one of the latest 8-core M3 processors, 8GB of Universal Memory and a 256GB SSD. Sure, that amount of storage means you have to work almost entirely from the cloud and modern web browsers will chew through that memory allocation, but if you're organised that processor is more powerful than most of Intel's laptop i7 CPUs. For those that are happy to confine their workflow to one or two tasks you can work extremely efficiently.

Doubling that memory or storage allocation will cost you $300 each, as will a GPU upgrade from the standard 8 core to the 10 core variation. While that is a little steep for RAM and onboard storage, adding these will go a long way to creating a more well rounded PC and the $2,799 total isn't bad value, all things considered. The $300 GPU upgrade is less essential, but it does come with two additional USB 3 ports and an Ethernet connection ($40) so it makes sense for anyone looking for a little extra graphical edge.

The 10-core M3 GPU we tested performed almost identically to an Intel Arc 370M discrete GPU we tried on an HP Spectre X360 a couple of issues ago (*APC* 526). This means it's about 20% behind a Nvidia RTX 3050 and will allow playable, 30fps-plus framerates on games like Balduers gate using 2560 x 1440 pixel Medium graphical settings. But while the entry level gaming capabilities are nice, for anyone with more demanding graphical workflows the iMac's proficient GPU makes it a realistic option. It's not the same level of graphical capability as you'll get from any of the Pro, Max or Ultra Apple chips. The 19-core M2 pro GPU offers 50% more graphical processing power than the 10-core M3 GPU, for example, but the iMac has enough grunt for slightly more demanding graphical workflows.

The iMac maintains its colourful appearance with seven colour options to choose from and the sleek profile will look great in open plan office spaces. The included wireless mouse and keyboard work well and offer advanced features like rechargeable batteries and a fingerprint sensor that can open the user's account it detects. The only downside was a slower 3,000MB/s SSD, which is about half the speed of current NVMe SSDs. ■

BENCHMARK RESULTS	Apple iMac (M3)	Apple Mac Mini M2 Pro
Geekbench 5 - Multi-core (score)	10,487	14,671
Cinebench R23 - multi-threaded CPU	10,379	14,876
Thermal Design Power (TDP)	85W	100W
Geekbench 5 - Open CL (score)	31,304	47,785
Geekbench 5 - Metal (score)	34,987	52,098
Baldur's Gate (score)	30	30
CrystalDiskMark Read (MB/s)	2,987	7,020
CrystalDiskMark Write (MB/s)	2,886	5,779

VERDICT

★★★★½

Pro level screen, excellent power and all the peripherals you need for a fair price.
Joel Burgess

apc EDITOR'S CHOICE

PRICE $2,399 **WEB** alliedgamingpc.com.au

Allied Stinger-A

An affordable gaming PC with grunt where it counts.

The market for pre-built gaming PCs can be a bit overwhelming for those who care less about what's under the hood, and more about the games themselves, particularly if you're on a budget. If you are after a new gaming PC, Allied is a well-established and growing Australian-based PC maker that should definitely not be overlooked.

For review we have Allied's Stinger-A gaming PC. It arrives double-boxed with a dedicated set of accessories and easy to follow setup instructions. The accessories include a Shuriken mouse, backpack, large stickers and a lanyard. The PC itself has a lot of internal air pillows to protect against damage during transit.

At a glance, it's obvious this is a well built and attractive gaming PC. It's a compact white themed rig featuring white cable sleeving. It's decked out with no less than seven RGB fans, and it comes with RGB memory too.

Allied chose to equip the Stinger-A with an RTX 4060 Ti 8GB graphics card. If you want to buy an affordable gaming PC, the number one most important component is the graphics card. The Stinger-A's PNY RTX 4060 Ti is a solid choice for a PC in this price range. The AMD Ryzen 5 5600 six-core processor isn't the most powerful chip by 2023 standards, but given the choice between a faster CPU or a faster GPU, a faster GPU wins every time. The Stinger-A is customisable too, so if you want more RAM, a better processor or more storage, you can choose to upgrade them.

The motherboard is a basic B550 model. The rear I/O is on the light side, featuring just six USB ports made up of four USB 2.0 ports and a pair of USB 3.0 ports. For a pure gamer looking to use undemanding devices like a keyboard, mouse and headset and perhaps an external HDD you should be fine, but 10Gbps+ USB is missing, as are Type-C ports.

The case itself features plenty of airflow potential with dust protection. Its three intake fans are matched by three outtake fans. That's the kind of set up we like to see for gaming rigs during hot Australian summers. Tempered glass side panels allow you to ogle the system. The white cable sleeving and cooler really do stand out nicely.

If the rear I/O of the system is underwhelming, the front makes up for it a bit. You get three Type-A USB ports, one of which supports USB 3.0. Power and reset buttons are joined by a headphone and microphone ports.

The Allied Stinger-A's RTX 4060 Ti is a solid option for 1080p gamers. It'll happily perform at higher resolutions but you'll have to give up some image quality in demanding ray traced games in order to run them smoothly. Alternatively, you can enable Nvidia's DLSS and frame generation technologies in supporting games for healthy FPS boost. Any of the popular multiplayer games like *CS:GO*, *PUBG* or *Fortnite* will run on the Stinger-A with ease.

SPECS CPU AMD Ryzen 5 5600; **COOLING** Allied Sidewinder ARGB 120mm Air Cooler; **MOTHERBOARD CHIPSET** B550; **MEMORY** 16GB (2x 8GB) DDR4-3200; **GRAPHICS** GeForce RTX 4060 Ti 8GB; **STORAGE** 1TB NVMe SSD; **POWER** 750W; **WARRANTY** 2 years RTB.

BENCHMARK RESULTS	ThermalTake Citadel V2	Thermaltake The Citadel	Allied Stinger-A
PCMark 10 - Overall (score)	7,198	6,526	9,662
Geekbench 5 - Multi-core (score)	8,437	6,967	8,028
Max CPU Temp (C)	71	70	73
Cinebench R23 - multi-threaded CPU	11,670	9,370	11,107
3DMark Time Spy (score)	10,220	8,608	12,067
Sid Meier's: Civilization VI - 1080p Ultra (fps avg.)	192	157	233
CrystalDiskMark Read (MB/s)	3,659	2,267	3,713
CrystalDiskMark Write (MB/s)	2,845	2,051	2,520

VERDICT

★★★★½

The Allied Stinger-A's emphasis on a higher performing GPU over everything else gives it serious gaming chops.

Chris Szewczyk

PRICE $259.95 **WEB** fitbit.com/global/au/home

Fitbit Charge 6

Supercharge your health monitoring with this affordable fitness tracker.

The Charge range from Fitbit has maintained its dominance in the fitness wearable space thanks to a great balance of features, battery life and cost. At $259.95 this fitness tracker is one of the best value offerings you can get, featuring advanced heart rate, connected-GPS and blood oxygen tracking to give you easy-to-understand data on your workout intensity, cardio fitness and your daily exercise readiness score.

All this information helps you work out the most efficient times, durations and intensity of workouts to ensure you're working efficiently. The new Charge 6 builds on this solid foundation by harnessing Google AI algorithms to improve the heart rate tracking by up to 60% in particular exercises. It's also got an expanded range of exercise tracking modes and compatibility with major exercise machine makers like iFit, Peloton and NordicTrack to help.

Fitbit has taken a wider lens on fitness over the last five or so years working heavily on sleep and stress management. This means tools like sleep tracking and stress management scores return on the Charge 6 to give you insights on how your day impacted your physiological state to allow you to try and intervene when there are issues.

The other major update on the Charge 6 is new YouTube Music controls and Google Maps turn-by-turn directions. While the former is a welcome improvement to what has been a bit of an unfortunate gap following the removal of Spotify compatibility when Google acquired the fitness trackers, it's not exactly revolutionary since it's just a controller for the smartphone app. The Google maps integration however, is actually a handy inclusion if you're riding a bike or walking and you aren't able to look at your phone for directions. The turn-by-turn navigation can be a little fiddly, but it's handy for those times you have nothing else to guide you. Like the YouTube Music app it requires a connected smartphone to drive the experience, but this outsourcing is part of the reason the device is able to maintain its affordability and battery life.

The Charge 6 offers the same 1.04-inch screen size as its predecessors and comes with the same 50m water resistance metrics, allowing you to take the device in the pool or surf to measure your aquatic activity without concern. You'll also still get up to a week of charge, making it much more convenient than a smartwatch and allowing you to track your sleep every night.

For those with heart conditions it even includes ECG capabilities so you can check for rhythm abnormalities if you're feeling a little off and the device's background heart rate monitoring will alert you to any abnormalities that you might not even realise are occurring.

There's not a heap of new features so if you can get the Charge 5 or Versa 4 on a discount you won't miss out on too much in this update, but against other smartwatches and fitness trackers this is still one of the best value options around.

SPECS 1.04-inch AMOLED touchscreen; up to 7-day battery life; optical heart rate monitor, SpO2; YouTube Music control, Google Wallet, Google Maps (app connected);GPS + GLONASS; 5ATM water resistance (50m); 3.87x1.86x1.17cm, 37g.

"The new Charge 6 builds on this solid foundation by harnessing Google AI algorithms to improve the heart rate tracking by up to 60% in particular exercises."

VERDICT

★★★★½

A light upgrade to the leading fitness tracker.

Joel Burgess

SPECS TH240 V2 Ultra ARGB 2.1" LCD Display All-In-One Liquid CPU Cooler; 460mm Tubes; AMD AM5, AM4, AM3(+), AM2(+), FM2, FM1, Intel LGA 1700, 1200, 115x,2066, 2011(-3) compatible; 2x CT120 500~2000 RPM PWM fans; max 25.8dB(A) Noise Level.

PRICE $239 **WEB** www.thermaltake.com.au

Thermaltake TH240 V2 Ultra

A premium AIO cooler, but only when matched with the right components.

If you're reading this, the chances are you're aware that the latest CPUs can get pretty hot. It's more important than ever to invest in a good cooler. Not just to keep your CPU running at acceptable temperatures, but to keep clock speeds at their highest levels too.

Thermaltake's TH series coolers cover all price points. While the hottest chips like the i9 14900K or nearly-as-hot Ryzen 9 7950X3D require a 360mm cooler, those with less demanding chips shouldn't have to give up the premium features and aesthetics that go with such coolers. Thermaltake's TH240 V2 Ultra ARGB cooler is a good example. It comes with an integrated 2.1-in LCD and it's well priced at $239. It's a premium cooler for mainstream CPUs.

As a modern AIO cooler, essentially all of the recent sockets are supported, with the exception of AMD's Threadripper range. The copper baseplate of the TH240 V2 Ultra is easily large enough to ensure adequate coverage of modern CPUs.

The V2 version we have for review has received some design tweaks. The head unit now has a more discrete, industrial look. That's fine as it leaves your attention focused on the lovely 480 x 480 2.1-inch LCD screen. You can use it to show off your own JPGs, GIFs, or MP4s among others. The TT RGB plus software can be used to display monitoring information about CPU, the weather and local time. LCD equipped coolers are not unheard of at $239, but historically, coolers with integrated screens tend to cost more, and sometimes a lot more.

Installation is a fairly straightforward process and the whole unit is solidly built. Long 460mm tubes really help with installation in larger cases.

The TH240 V2 Ultra comes with a pair of CT120 ARGB fans. A pair of these fans can set you back $49 alone. They're equipped with hydraulic bearings and rated to run between 200 RPM and 2,000 RPM at a maximum noise level of 25.8 dB-A. Their connections are daisy-chained, allowing you to control both fans via single 4-pin PWM and 3-pin ARGB headers. Thermaltake includes two pairs of 900mm extension cables, which really helps with cable management.

Our testing showed the CT240 fans' rated noise levels to be optimistic, but it had no problem handling a Core i5 14600K under a full load, recording a peak temperature of 85 degrees. That's about as powerful a CPU we'd recommend though. High core count CPUs will stress even a 360mm AIO. It's important to pair the TH 240V2 Ultra with the right hardware. If you have a high end CPU, Thermaltake offers 360mm and 420mm versions of the TH series V2 coolers.

Thermaltake has priced the TH240 V2 Ultra quite aggressively. It's listed at Thermaltake's webstore for $239 but we can see listings under $200 and that makes it a very good price indeed for an LCD equipped 240mm AIO cooler.

The TH 240 V2 Ultra is an impressive and capable 240mm cooler that looks fantastic, particularly the 2.1-in customisable LCD. It's affordable and quiet under light loads, though less so under a heavy load (as expected). If you're after a premium yet affordable 240mm cooler, TH240 V2 Ultra deserves a spot on your cooling shortlist. ■

VERDICT

★★★★½

The TH240 V2 Ultra performs well, it looks great and it's priced aggressively. Do pair it with a mid-range CPU to avoid unduly stressing it though.

Chris Szewczyk

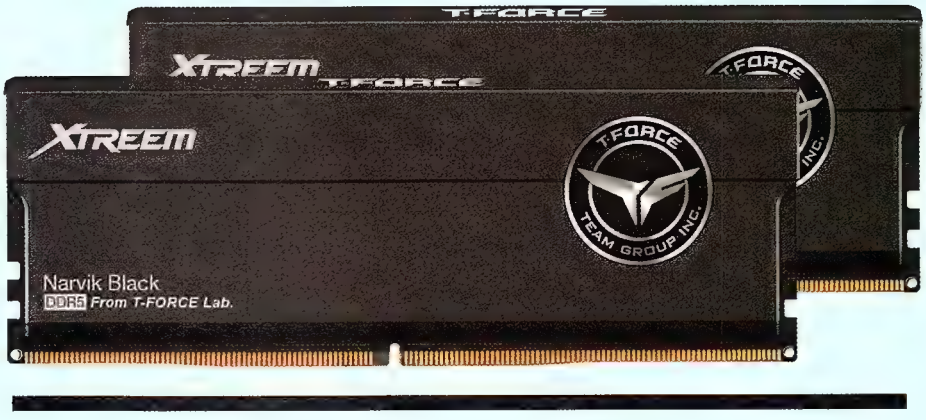
PRICE $629 **WEB** www.teamgroupinc.com

Teamgroup T-Force Xtreem DDR5-8200 2x24GB

You might want it, but do you need it?

DDR5 memory speeds continue to climb upwards. Nowadays, some four-slot Z790 refresh motherboards are capable of supporting 8000MHz+, and even AMD's Ryzen 7000-series CPUs are capable of such speeds with the latest BIOS updates.

One of the fastest memory kits on the market comes from Teamgroup. Its T-Force Xtreem DDR5 memory is available in speeds of 7600MHz, 8000MHz and 8200MHz. All speeds are available in either 2x16GB kit or 2x24GB capacities. We've got the 2x24GB 8200MHz kit on hand for review. It comes with 38-49-49-84 timings at 1.4V.



SPECS 38-49-49-84 at 1.4V; XMP 3.0 Support; Limited Lifetime Warranty

At $629, this is a memory kit that's predominantly aimed at enthusiasts and overclockers. If your PC includes anything less than a high end CPU, motherboard and graphics card, you'll be better served with slower and cheaper memory.

The design is a subtle all black finish with just a bit of text plus the T-Force logo. Not that it lacks style, but you'll need to look elsewhere if you want RGB. The heatsinks are 2mm thick with fins at the top. They're designed for cooling first and foremost. The modules are quite tall at 48.8mm so you'll need to check to be sure it'll fit underneath a large tower cooler.

The kit comes with XMP 3.0 support, but you should not rely on XMP at these speeds. Even if you do get it going, you should check your BIOS to ensure the motherboard isn't applying some crazy chip degrading level of voltage. For this review I used a Gigabyte Z790 Aorus Master X. It's a 4-slot motherboard that unofficially supports speeds of up to 8266MHz. However, enabling XMP resulted in a no-post with this board with the F5D BIOS. I had to increase VDDQ and VCCSA voltages into the 1.4V range to get it to work at 8200MHz. That's not recommended for use 24/7. I didn't test with AMD, but it's safe to say that if you do buy this kit, you'll get the best results with overclocking focused motherboards, such as the Asus Maximus Z790 Apex and the Gigabyte Z790 Aorus Tachyon X.

The 8200MHz Xtreem kit thrives in traditionally memory sensitive apps and benchmarks, particularly the file compression and video encoding tests, though as expected, some apps hardly benefit. If at all. It's a similar story in games. Some benefit, while others show no gain at all. With anything less than a top spec system, you're better off saving some money and putting it towards a faster CPU or GPU that will deliver more tangible performance improvements.

On the other hand, such a kit will surely live through many upgrades. 48GB at 8200MHz will remain relevant for years to come. With DDR6 memory several years away with years of overlap beyond that, you could think of such a DDR5 kit as a long term investment.

In the end, the conclusions from just about any high speed DDR5 memory review can be applied here. It's memory for those who want the best. If the pursuit of performance is at the top of your wishlist, by all means, go for it. For typical users though, it's overkill with a capital O.

BENCHMARK RESULTS

	Teamgroup Xtreem DDR5-8200 2x24GB	G.Skill Trident Z5 DDR5-7200 2x24GB	Kingston Fury Beast DDR5-6000 2x16GB
Handbrake 1.7 - Video conversion - 4K to 1080p FPS	163.8	157.9	154.8
Cinebench R23 - Rendering - Multi thread Score	40,512	40,311	39,986
Cinebench R23 - Rendering - Single thread Score	2,354	2,350	2,324
7Zip 21.03 - File Compression - Billion Instructions per second	229.42	209.65	203.02
Cyberpunk 2077 - 1080p, RT Ultra + DLSS, Avg FPS	265	261	259
Metro: Exodus Enhanced Edition - 1080p, High, DX12, Avg FPS	169	165	155
Total War Warhammer III - 1080p, Low, Avg FPS	247	247	246

VERDICT

Teamgroup's Xtreem DDR5 will appeal to enthusiasts and overclockers, but it's overkill with anything less than a flagship-tier system.
Chris Szewczyk

PRICE $3,849 **WEB** www.qnap.com

QNAP TVS-h674T NAS

A six-bay NAS with Thunderbolt 4. How much time and money could it save you?

QNAP's TVS-h674T fulfils the NAS-based promise of Thunderbolt 4 connectivity. It's aimed at creators and small studios who want multiple users to be able to upload, edit and share UHD video across a network without relying on the traditional bane of multiple, expensive, shared, single-connection, tethered hard drives.

There are six, tool-less, lockable and hotswappable, 3.5-inch drive bays (included screws are needed for 2.5-inch SSDs). There are also two M.2 2280 PCIe 4.0 slots for fast NVMe drives that can be used for super-fast storage or SSD caching. For the latter, they can be optimised for virtualisation and database applications (Random I/O) or file serving and media streaming (All I/O).

QNAP states that using six, 22TB drives provides a maximum 110TB of formatted storage capacity but this can be pushed to 352TB when using QNAP's optional JBOD enclosures.

Just beware that you need to check QNAP's website for drive compatibility as few third-party drives are supported. Still, the fact that any are supported at all is a win considering that Synology only supports Synology-branded drives nowadays.

Two SODIMM slots are populated with two (non ECC) 16GB memory modules (upgradable to 32GB). Note that QNAP recommends its own branded RAM but doesn't require it. At the back are two 2.5Gb Ethernet ports, an HDMI 1.4b port, plus two USB 3.2 Gen 2 ports (Type-A and a Type-C). There's another Type-C port at the front.

"QNAP states that using six, 22TB drives provides a maximum 110TB of formatted storage capacity but this can be pushed to 352TB when using QNAP's optional JBOD enclosures."

SPECS 2.5-4GHz hexa-core Intel Core i5-12400 CPU, 32GB DDR4 RAM (expandable to 64GB). 6x drive bays, 2 x M.2 2280 PCIe 4 x4 slots, 2 x Thunderbolt 4, 1 x USB-C 3.2 Gen 2, 2 x USB-A 3.2 Gen 2, 1 x HDMI 1.4b, 2 x 2.5Gb Ethernet ports; QuTS hero 5.1.4 operating system.

There are also two PCIe 4.0 slots. One (4 x4), comes populated with a two-port Thunderbolt 4 card. The other (4 x16) can be used to add additional, faster network ports (that facilitate up-to 25GbE speeds) or additional M.2 slots. It can also be used to add a small, low-powered, discreet graphics card for things like AI-based applications. You may need the latter as the 12th-Gen, Intel Core i5-12400 hexacore processor (with Hyperthreading) has a modest, integrated UHD 730 GPU. It can transcode RAW footage on the fly but will struggle with more-powerful demands.

Set-up is simple, in that you plug it into your network, go to the supplied web address and follow the instructions. The QuTS hero 5.1.4 browser-based operating system is intuitive and makes setting-up storage and cache a breeze. It also comes with a well-stocked app store for just about any NAS application.

When used with SSD cache, we found that the Theoretical 40Gbps Thunderbolt 4 connection speed wasn't quite achieved. It's hard to test over (even) a fast network environment (which also deals with theoretical speeds) but, while we couldn't match the promised performance, we did see write speeds fluctuating around 600MB/s and read speeds hitting 1,700MB/s. If you work with video and are sick of hanging around, this will likely represent a significant improvement but, at this level, the true benefits will heavily depend upon the file types you use and your network environment.

The TVS-h674T is available now at $3,849. While it's not cheap compared to slower rivals (and siblings), the collective hours saved in reduced transfer speeds (and the reduced requirement for expensive hard drives) mean could pay for itself.

VERDICT

★★★★★

It's expensive, but the improved Thunderbolt 4 performance could help it pay for itself.
Nick Ross

PRICE Varies per component **WEB** https://c2.synology.com

Synology C2 Cloud

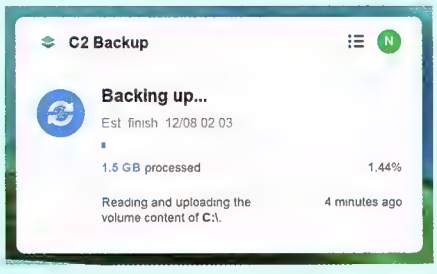
Synology's cloud services have matured and you may be surprised what's on offer.

Whether you're a long-term Synology NAS user or a novice, you might not know about Synology's (mostly) premium C2 cloud services.

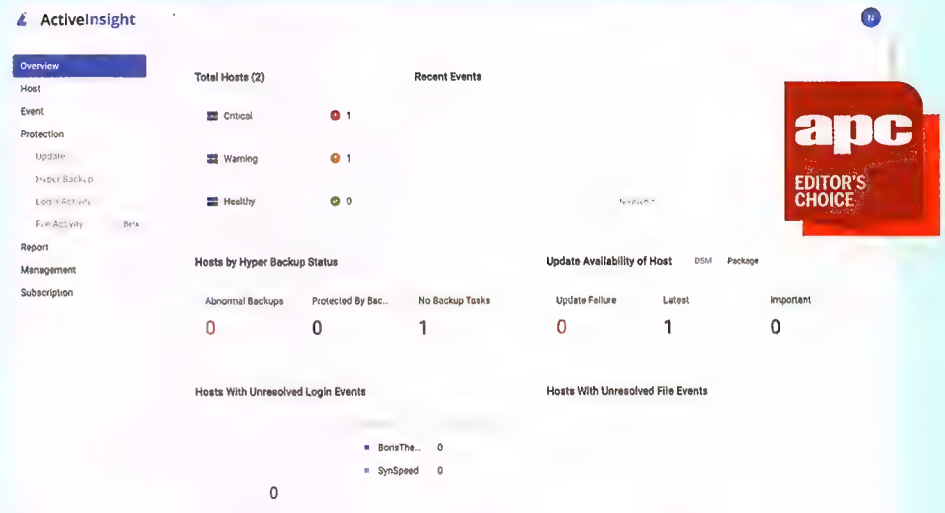
At the basic level there's C2 Password which can secure personal ID, payment and bank details and act as a password manager for individuals (free) or entire organisations (US$5 annually for six users or US$200 annually per ten users). The resulting data vaults can be used personally or shared and all can be synchronised across multiple devices. It can also provision secure file transfers and use one-time passwords with them. A Chrome extension enables easy access on the web and everything is secured via 256-bit AES encryption that's controlled by you.

C2 Backup is something of a missing link for Synology. Any proper backup environment requires an off-site element and C2 provides multiple tiers to partner with its NAS boxes. Personal accounts cost US$35, US$100 and US$250 for 500GB, 2TB and 5TB plans, respectively. Backups can be utilised across unlimited devices and include incremental and versioning support, plus full Windows PC restoration. Business plans scale from US$500 for 5TB but can support unlimited users and teams with custom permissions.

C2 Transfer facilitates file transfers which will be attractive to those who rely on gofile.me on their own NAS boxes that are often stuck behind horrendous internet upload-speed bottlenecks and take forever when multiple users are trying to download a single file across the internet. A professional account is US$100 and offers 1TB storage with a 30GB individual file-size limitation. The Business version is US$500



ABOVE C2 Hybrid Backup can sync your NAS files to Synology Cloud (as well as public clouds) providing some useful redundancy that can help with disaster recovery should catastrophe befall your onsite NAS box(es).



ABOVE Synology's ActiveInsight gives you a remote, browser-based view of both your local NAS boxes and cloud services.

SPECS Password management, backup for individuals and businesses, file transfer, identity management, object storage for developers; hybrid cloud storage and surveillance services.

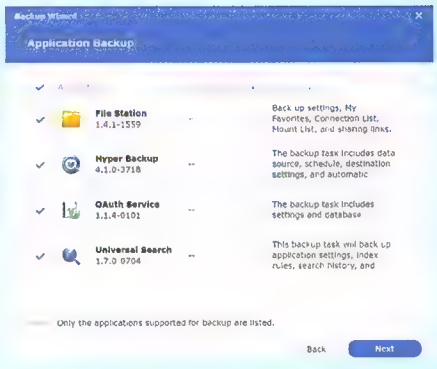
annually per five users and provides 5TB storage and 500GB file-size transfers.

The Identity manager is free for individuals but starts at US$200 annually per 10 users for business. It authenticates users across multiple applications and can integrate with SSO from the likes of Google and Microsoft 365.

Finally, there's C2 Object storage for developers which has AWS S3 APIs. Plans start at 15TB (free tier) and scales at US$70 per terabyte per year. Synology promises there are no hidden costs which could be very attractive.

There are the Hybrid Cloud backup services which can sync (at least the most important) files on your NAS with the cloud. A basic 1TB plan costs US$60 per year but you can make use of hourly backups, data deduplication and customisable retention policies for $US10 more. It can also work with Synology's excellent Surveillance Station NAS software with plans starting at US$9 per camera per year for seven-day retention of HD video and scaling to UHD 24/7 streaming at a negotiable cost.

In terms of data sovereignty, you can host services on Synology's US, Frankfurt and/or Taiwan-based clouds. This will instantly preclude some major organisations (like


Application Backup
File Station 1.4.1-1559
Back up settings, My Favorites, Connection List, Mount List, and sharing links.
Hyper Backup 4.1.0-3718
The backup task includes data source, schedule, destination settings, and automatic
OAuth Service 1.1.4-0101
The backup task includes settings and database
Universal Search 1.7.0-0704
This backup task will back up application settings, index rules, search history, and
Only the applications supported for backup are listed.
Back
Next

ABOVE C2 Backup enables you to backup devices direct to the Synology Cloud, bypassing the NAS.

governments) from using a service that's not local.

Everything is simple to manage via the C2 portal and performance largely depends on your own internet infrastructure. Demanding enterprises and verticals will likely look to specialist managed services providers instead, but for SMBs embedded in Synology hardware, at least some of these services will be the missing piece of the puzzle. ■

VERDICT

★★★★★

The missing pieces to the Synology puzzle are plentiful and represent good value.

Nick Ross

PRICE $949 (128GB), $1,199 (512GB) **WEB** meta.com

Meta Quest 3

Next-gen VR that teaches Apple a thing or two about value.

Apple's Vision Pro has reset expectations of what a mixed reality headset can be, but two big things stand in its way: a likely price of $3,500 and uncertainty over its release date in Australia. Until now, your best mixed reality bet was the Meta Quest 2 – but the Meta Quest 3 improves on it in just about every way.

For a start, the visor is a drastic 40% slimmer than its predecessor, which makes the Quest 3 far more comfortable to wear. While I can't claim that I ever forgot I was wearing a headset on my face, I did feel a noticeable difference from the top-heavy Quest 2.

Thanks to the slimmer design, Meta ditched the spacer for users like me who need glasses. Instead, you adjust the "facial interface" using two black buttons inside the headset, which will give you more space if needed. There's also a new IPD wheel for adjusting the distance between the lenses. The stock settings let me wear the Quest 3 with my glasses on easily, but it's easy to make tweaks.

Boosted display

Pancake optics are one key reason why the visor is slimmer. Also known as pancake lenses, these layer thin lenses to reproduce images in a smaller space. The displays also include a higher resolution than the Quest 2: 2,064 x 2,208 per eye compared to 1,832 x 1,920; Meta dubs them 4K+ Infinite Display because the two IPS panels combine for 4K resolution.

That resolution translates into 25 pixels per degree (PPD) when in virtual reality and a pixel density of 1,218 pixels per inch (PPI). By default, the displays have a 90Hz native refresh rate, but developers can take advantage of an experimental 120Hz refresh rate.

But what really matters is that these improvements are very noticeable. Colours are more vibrant on the Quest 3 than the Quest 2 and – despite only being powered by a mobile chipset - the graphics impress. It still doesn't match what you can get from a PC VR headset but once you start playing you don't care.

The one place where you will notice a drop-off in graphical fidelity is the video passthrough. PPD drops from 25 to 18 and you will see judder when you look at your arms and hands. However, the

SPECS Qualcomm Snapdragon XR2 Gen 2 processor; 8GB RAM; 128GB/512GB storage; dual 2,064 x 2,208 120Hz IPS screens; 110° horizontal, 96° vertical field of view; 2 x colour pass-through cameras; 4 x IR tracking cameras; integrated stereo speakers; USB-C power port; Wi-Fi 6E; Bluetooth 5.2; 2 x handheld controllers; 184 x 160 x 98mm (WDH); 515g; 1yr warranty.

augmented reality holographic overlays maintain their visually stunning look in passthrough, so even if your surroundings are in lower fidelity your game won't be.

Meta has also worked hard on the audio side, boosting the volume levels by 40%. I never needed to crank up the volume, to the point that it's so loud that anyone else in the room will know you're playing. If you want privacy, your easiest option is to connect a pair of wired earbuds through the 3.5 mm headphone jack. Unfortunately, you can't connect most wireless earbuds despite Bluetooth 5.2 support due to latency issues. One workaround is to buy wireless earbuds that use a USB-C dongle to ensure latency isn't an issue.

I also definitely noticed the improved spatial audio. In First Encounters and Dungeons of Eternity, it was very helpful in determining where enemies were spawning or coming from. In games like *Samba de Amigo* and *Pistol Whip*, it also provides full, rich sound – great for music-driven rhythm games – but the real advantage for me came in games where being aware of your surroundings matters.

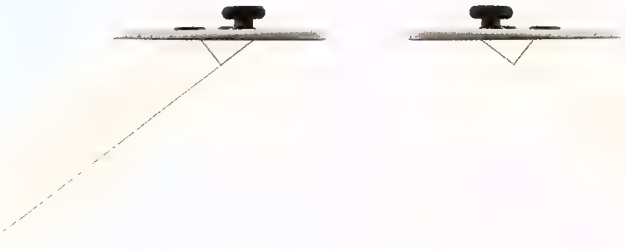
> "By default, the displays have a 90Hz native refresh rate, but developers can take advantage of an experimental 120Hz refresh rate."

Slick control

The new Touch Plus controllers may be my favourite thing about the Meta Quest 3. They don't look drastically different at first glance, but the tracking ring found on the Quest 2's Touch controllers is gone. Instead, they adopt the ringless design of the Touch Pro.

They fit perfectly in your hand, to the extent that every time I pick them up, I marvel at the design.

Despite losing the tracking ring, the Touch Plus controllers still manage 6DoF tracking, which means you can walk around your playspace with no problem despite the lack of a tracking ring. The Touch Plus controllers also use haptics so



you can feel resistance when using the controllers for better feedback and immersion. I wish the feedback was stronger and more nuanced – I often found myself forgetting it was even there – but it's still a nice addition.

Aside from using the Touch Plus controllers, you can also use hand tracking (Direct Touch in Meta's parlance) to navigate the Quest 3's screens and even in certain games and apps. You switch to hand tracking by double-tapping the sides of your controllers and setting them down. I like the idea, especially when browsing through controls, but whenever I used Direct Touch I soon yearned for the controllers and haptic feedback.

Easy setup

Setting up the Meta Quest 3 is painless. The headset will guide you through the process, including pairing the Quest 3 with the Meta Quest app on your phone. You can even connect the headset to your Wi-Fi network using a QR code on your phone, which you can see thanks to the headset's full-colour passthrough powered by two RGB cameras on the front of the visor.

These cameras, a depth sensor and the Quest 3's passthrough also come in handy when setting up your play space. You get two options for operating in virtual reality: Roomscale and Stationary. Stationary gives you a circle to work within, and is ideal if you're seated when using the Quest 3.

Roomscale pulls in the visuals of your room from the passthrough and gives you a suggested playspace that you can further adjust with your controllers. I found that I always needed to tweak things a little, and walking around the room helped the automatic boundary set at the right limits.

The passthrough even takes things a step further for playing in mixed reality rather than virtual reality. During setup for your first mixed reality experience, you'll be asked to highlight or create your room's walls using the controller. After you've done that, you'll be asked to look around the room so the headset can scan for any furniture. You'll see a virtual mesh or polygons covering your furniture. Once that's done you're good to go for playing in mixed reality.

In terms of life, expect around two hours; that's almost exactly how long it lasted when I played a handful of Quest 3 and Quest 2 games and watched probably 30 minutes of *District 9* using the Pluto TV app. Once it's dead you can recharge the Quest 3 in, coincidentally, roughly two hours.

Gaming action

Qualcomm's new Snapdragon XR2 Gen 2 provides the power, with Meta claiming it has twice the graphics abilities of the Quest 2. You also get 8GB of RAM instead of the 6GB. There's no real way to test Meta's claim, but in practice I found the headset to be notably responsive. Whether playing *Samba de Amigo*, *Pistol Whip* or a mixed reality experience such as *First Encounters*, the Quest 3 never lagged on me, even while downloading apps in the background.

You're still not getting hyper-realistic graphics, but it's a big step forward from the graphics on some older Meta Quest 2 games. Take the *NFL Pro Era* app: this ran smoothly, and remains enjoyable, but the *Quest 2* level graphics felt like stepping into an old arcade game.

That's worth bearing in mind: while you do get access to the 500+ catalogue of Quest 2 games, only a few (such as *Pistol Whip*) have been upgraded to take advantage of the Quest 3's superior performance. It looks great, and native

Quest 3 games such as *Assassin's Creed Nexus* are visually impressive too.

One thing didn't impress me: Xtadium, Meta's app for viewing sporting events in VR. You can only view highlights for now, and it feels like a low-quality, low-res video feed was being superimposed over a backdrop rather than watching the action from a true 180-degree or 360-degree camera. I hope live NBA games look better, because as it stands there's no way I'd choose it over my TV, let alone a live game.

Mixed verdict

But here's my biggest criticism of the Quest 3: it doesn't yet feel like a mixed reality headset. Sure, you start out in mixed reality as you see a video passthrough recreation of your surroundings, but I want more games to really harness the ability to interact with your surroundings. Most of the games, even with the enhancements, are still just virtual reality games.

In the few mixed reality games I played, the experience was fun. *First Encounters* did a good job of integrating your environment into the gameplay with destructible walls. And *Lego Bricktales*, a tabletop experience, cleverly mixes your surroundings with a virtual world. I would argue that most tabletop experiences benefit from mixed reality, having now played two in *Bricktales* and *Demeo*. You don't need to be taken fully out of reality to play them, so it's nice to remain grounded in your setting.

> "Hopefully, as time goes on more apps will come out taking full advantage of the Quest 3's video passthrough, which did impress me when I got to use it."

Hopefully, as time goes on more apps will come out taking full advantage of the Quest 3's video passthrough, which did impress me when I got to use it. But until then, the Quest 3 underwhelms when it comes to mixed reality features.

Still, the Meta Quest 3 is a clear improvement on the Quest 2. It's thinner, lighter, more comfortable to wear and more comfortable to use than the older Quest 2. And both the display resolution and graphics are a noticeable step up. Another reason to choose this over, say, the Sony PSVR 2 is that you can connect it to a PC top play nearly all of the best VR games if you buy the optional Link cable or Air Bridge accessory.

Will the Meta Quest 3 tempt new people into "virtual" reality? Until it delivers on its mixed reality promises, that's a straight no. But until an affordable version of Apple's headset arrives, the Quest 3 is the one to buy. ■

VERDICT

★★★★★

A big improvement over the Quest 2 for graphics and mixed reality – you won't find anything better at this price.

Malcolm McMillan

PRICE $1,299 **WEB** lenovo.com

Lenovo Legion Go

A handheld PC designed for gaming on the move and, while not perfect, it delivers for speed and quality.

The Lenovo Legion Go is an all-in-one handheld PC, aimed primarily at gamers. So why, you might ask, is it basking in a two-page review within APC? The answer is that it has enough versatility to also serve as a general-purpose computing companion.

It's not the only such system out there. Asus released its ROG Ally earlier this year and the Steam Deck remains a great choice if all you want to do is play games from your Steam library. Where the Go stands apart is that this is a slick and well-engineered device that I can imagine someone choosing to bring with them on a business trip rather than a laptop.

Big is beautiful

The Legion Go is a sizeable thing, measuring 299mm from end to end and weighing a not insubstantial 854g. However, the chunky frame means there's room for a spacious 8.8in IPS display, and it's still lighter than almost any laptop. What's more – unlike the competition – the Legion Go has an integrated kickstand, so you can stand it up and play games, watch movies or use regular desktop apps for as long as you want, without having to hold the thing in your sweaty palms the whole time. It's a simple idea, but absolutely game-changing, and well implemented: the stand is reassuringly sturdy, with a wide and stable design that should stay put on any reasonably flat surface.

The Legion Go's also includes two side controllers, which can be detached like Nintendo Switch Joy-Cons, allowing you to sit back and hold one in each hand. Unlike Switch controllers, these units don't contain motion sensors, but they're still astonishingly good. The design is admirably ergonomic, with high-quality padding in just the right places. The sticks use Hall effect sensors, which means you don't need to worry about drift, and an LED light ring around them provides a handy immediate indication of each controllers' battery power and connection strength.

There's also a snap-on base that turns the right-hand controller into a sort of upright mouse, for extra precision in what Lenovo calls FPS mode. Plenty of other customisable buttons are scattered around the system, and even a touchpad; it can feel a little overwhelming, as if everywhere your fingers go they're in danger of inadvertently pressing something, but nothing activates unless you've assigned it a function.

Sharp display, sharp speeds

Perhaps the star of the show is the Legion Go's gorgeous 8.8in IPS display. With a native resolution of 2,560 x 1,600 it's far more detailed than the Asus ROG Ally or Steam Deck, and a 144Hz refresh rate ensures motion is perfectly smooth. It also covers a surprisingly high 97% of the DCI-P3 colour gamut, with vivid and eye-catching colours. Naturally it's touch-sensitive, too, and I found it felt perfectly accurate and responsive when navigating the OS.

Indeed, the whole thing feels highly responsive, thanks to very powerful internals. The Legion Go is built on an eight-core AMD Ryzen Z1 Extreme CPU, partnered with 16GB of LPDDR5 RAM and an integrated 12-core AMD RDNA GPU. This delivers strong benchmark scores: in Geekbench 6.2 we saw a single-core score of 2,143 and a

BENCHMARK RESULTS	Lenovo Legion Go
Geekbench 6.2 single-core	2,143
Geekbench 6.2 multicore	9,857
3DMark Time Spy	2,401
Battery life - Web surfing	4hrs 6mins
Battery life - Gaming	1hr 59mins

SPECS 8-core/16-thread AMD Ryzen Z1 Extreme processor; AMD Radeon graphics; 16GB LPDDR5 RAM; 8.8in 144Hz IPS touch panel, 2,560 x 1,600 resolution; 512GB M.2 PCI-E Gen 4 SSD; Wi-Fi 6E; Bluetooth 5.3; 2 x USB-C 4; 3.5mm headphone jack; microSD card reader; 49Wh battery; Windows 11 Home; 299 x 131 x 40.7mm (WDH with controllers); 854g; 1yr warranty.

multicore score of 9,857, which is impressively on a par with desktop PCs costing a simliar amount.

This shouldn't be too surprising. The Z1 Extreme is a power-optimised version of AMD's Ryzen 7840U mobile chips, designed to run at 15W rather than 30W. That means it includes the same Radeon 780M graphics, complete with 12 cores.

Gaming experience

The Legion Go's 3DMark results are less compelling than its productivity results, with a 6,451 return in Fire Strike and 2,401 in Time Spy. However, in practice there's enough horsepower to handle even the most demanding AAA games. For example, one of the first things I tried on the Legion Go was *Forza Horizon 5*: even with ray tracing turned on, I witnessed a smooth 51fps at full resolution with Medium detail settings. And to be clear, while Medium detail might sound like a compromise, it doesn't feel like one: I was blown away by how beautiful and detailed the car and environments were while racing. It really felt like I was gaming on a much bigger and more expensive system.

Audio quality was excellent as well, surprisingly so. The roar of the car's engine throbbed over the commentary, accompanied by fast-paced music with such depth and clarity that I once again forgot that I was playing on a handheld.

I had equally good experiences with every game I tried, from less demanding ones such as *Teenage Mutant Ninja Turtles: Shredder's Revenge* to top-tier titles such as *Baldur's Gate 3* and *Cyberpunk 2077*.

As well as offering impressive in-game performance, the portable device switches snappily between games, even ones from different PC storefronts. Loading can take a few moments, but the overall experience is very smooth, and even during extended gaming bouts I never noticed any heat-related stuttering or throttling.

Limited lives

On that point, although everything worked fine for me out of the box, you can switch between various thermal modes to achieve your preferred balance of performance and heat generation. The highest performance mode runs the fan at full blast, and is intended for use while the thing's plugged in, but there's nothing stopping you from using it in battery-powered mode: I found that even when the Legion Go was running flat out, it was never uncomfortably warm to hold.

Alternatively, if you want to eke out the longest possible battery life, you can switch to quiet mode, which runs the fan more slowly and throttles the hardware accordingly. You can define your own modes, too, if the presets don't quite suit you – or reduce your power demands by dialling down the graphical quality settings in your games. If you're investing in a high-end handheld gaming PC, however, you probably don't want to make the graphical compromises.

At any rate, even in maximum power-saving mode, the Legion Go inevitably provides only a couple of hours of gaming on a full battery, so you'll need to bring the charger with you when travelling. If you want to use the controllers in detached mode, they'll need to be charged, too: you can charge the whole system together, by ensuring they're connected when you plug in the main unit, but this will extend the charging time.

Beyond games

The Legion Go runs a full version of Windows 11 Home, with only a few Lenovo customisations to suit the format of the device. These include the Legion Space gaming front-end, which notionally brings all the major gaming services together into one interface, but it's not particularly helpful, as you still have to download and log into each one manually before you can use it. It's a lot less streamlined than the Steam Deck's custom Linux-based OS, which is designed for quick and easy setup and access to your games.

The upside is that you can install any Windows software you like on the Legion Go, including full-fat productivity applications. The Go's two USB-C connectors both support DisplayPort 1.4, so you can easily connect external displays and any other peripherals you might want to use, while Bluetooth 5.1 gives you easy wireless options for a keyboard and mouse.

At $1,299 the Legion Go is notably more expensive than its two main rivals, the Asus ROG Ally and the Steam Deck. However, as well as powerful internals, that price gets you 512GB of fast NVMe storage – and you can add more capacity via a standard microSD card slot. A cheaper edition is planned, too, based on a regular AMD Z1 processor, which has six Zen 4 cores to the Extreme's eight.

In all, the Lenovo Legion Go is an impressive machine. It has great performance, a beautiful display, excellent controllers, crystal-clear audio and more. If you're looking for a more compact, cheaper system then the Steam Deck or ROG Ally are still worth a look, but if you're in search of the best handheld PC gaming experience, plus the option of more serious computing on the move, the Legion Go is where it's at. ■

VERDICT

★★★★☆

Much more than just a hand-held games device, the Lenovo Legion Go is a powerful portable PC.
Allisa James

Also consider...

For handheld console gaming, the Nintendo Switch remains a hugely popular choice, selling more than 130 million units worldwide. You can buy it for $447 – although it's been out for six years now, and it's rumoured that a follow-up console could be in the works for Christmas 2024.

ASUS ROG ALLY

PRICE From $1,099 **WEB** rog.asus.com

If you prefer PC gaming, the Asus ROG Ally is a great little Windows 11 handheld. It has a gorgeous display, feels fantastic to hold and it provides you with access to your full PC gaming library.

Although performance isn't up to the level of the Lenovo Legion Go, it will handle modern titles at moderate-to-high frame rates, and it beats the Go on both price and compactness. Its major limitations are screen size – it has a 7in 1080p panel – and a battery life of less than two hours.

STEAM DECK

PRICE 256GB, $855 **WEB** store.steampowered.com

The Steam Deck is a cheaper option than the Asus ROG Ally, offering almost four hours of battery life. The custom SteamOS gives you slick access to your games, and while the 7in LCD panel doesn't match the technical specs of its rivals, games still look fantastic and run smoothly.

The upgraded Steam Deck OLED is out now, with prices starting at $1,299 (for the 512GB version). If you want to play your Steam games on the go without spending a fortune then this handheld is a great deal.

WEB www.marticliment.com/wingetui **NEEDS** Windows 10 or 11

FastStone Image Viewer 7.8

Image viewer

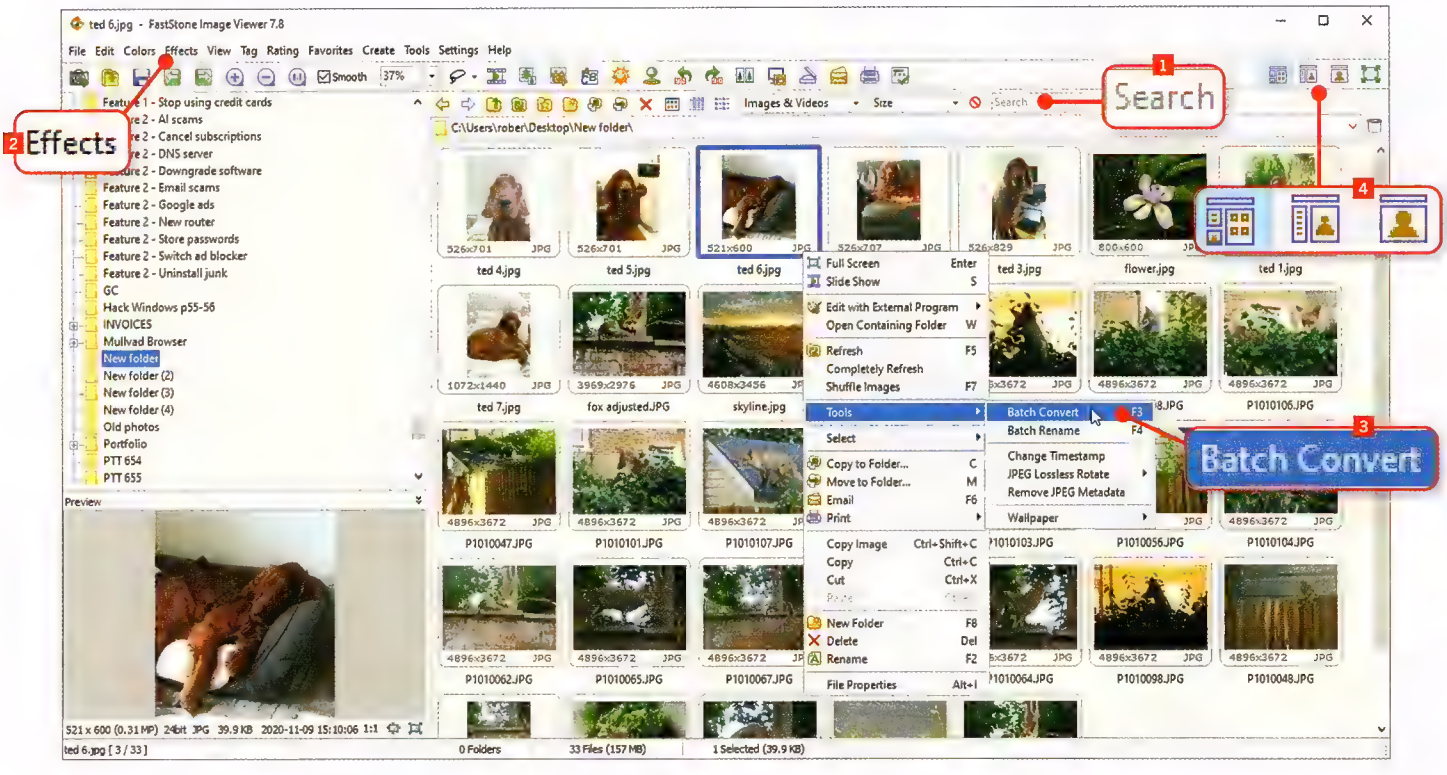
FastStone Image Viewer is one of our favourite free tools for browsing photos on your PC, with lots of useful features and support for a wide range of image formats. This latest version expands that list to include the AVIF format (which offers higher compression rates than JPEG) and adds new options that make the program even easier to use.

One of the most notable changes is the addition of a 'Search by Name' box to the toolbar that appears above FastStone Image Viewer's thumbnail browser (which shows all the images stored in the selected folder). This helps you quickly find a picture or video by typing a few letters of the file name, rather than sorting items by name to locate it alphabetically.

Equally useful is the introduction of drag-and-drop functionality to the program's viewing panel. Instead of clicking File then Open to display a photo in the viewing area, you can now simply drag and drop it from a folder in File Explorer, or an external drive such as a USB stick. The file will then open in the viewer, where you can zoom in, make adjustments and apply effects.

Two new options – Shadows and Highlights – have been added to the batch-conversion tool that lets you edit multiple images in one go. Tick the Use Advanced Options box in the Batch Image Convert window, then click the Advanced Options button that appears. Select 'Adjust Brightness...' on the Adjustments tab then click the 'Design and Preview' button and use the new Shadows and Highlights sliders to specify the intensity of those filters.

FastStone Image Viewer has also improved its Draw Board feature for annotating pictures. You can now apply shadows and outlines to text, flip and rotate image objects, and even insert emojis where appropriate. With so many handy features beyond mere image viewing, the program may soon have to change its name.



1 FastStone Image Viewer's new 'Search by Name' box makes it easier to find images and videos in the currently selected folder by typing a few letters of their file name. You can also filter pictures by date, size, type and other criteria.

2 The program's Effects menu lets you add a watermark to your pictures before you share them, surround images with a border or frame, and apply creative effects such as Oil Painting. You can also blur sensitive details.

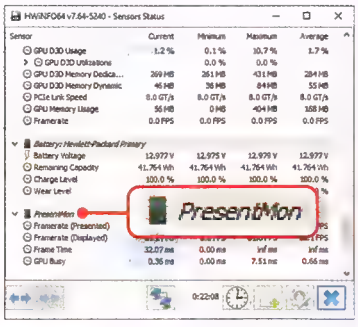
3 To convert or edit multiple images in one go, hold down Ctrl and left-click them in the thumbnail browser. Right-click and choose Batch Convert in the Tools menu, then tick Use Advanced Options to select your preferences.

4 Switch between FastStone Image Viewer's thumbnail browser and different viewing-panel layouts using the options in the top-right corner. As we explain above, you can now drag and drop images directly into the viewer.

HARDWARE MONITOR

HWiNFO 7.64

WEB www.hwinfo.com/download **NEEDS** Windows 7, 8.1, 10 or 11

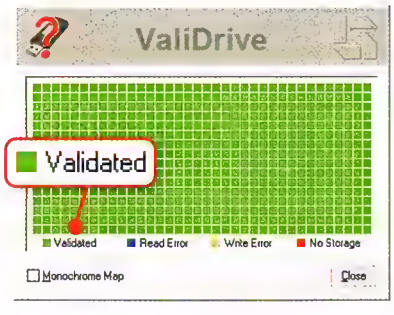


This powerful free tool for monitoring the hardware inside your computer has been updated to provide even more information. HWiNFO now includes Intel's PresentMon technology (see screenshot), which measures the frame rate and power usage of your graphics card, and is particularly useful for gamers who require optimum performance from their machines. It also offers improved monitoring of the fan speed in Asus laptops and the sensors in MSI motherboards. The Sensor column has been expanded so you can view the full name of each component. Additionally, the developer has fixed a bug that could cause the program to crash on CPUs with more than 64 cores. HWiNFO's long list of technical data can seem intimidating at first, but hovering your cursor over a section title or entry displays a pop-up explanation of what it means.

STORAGE CHECKER

ValiDrive 1.1

WEB www.grc.com/validrive.htm **NEEDS** Windows 7, 8.1, 10 or 11

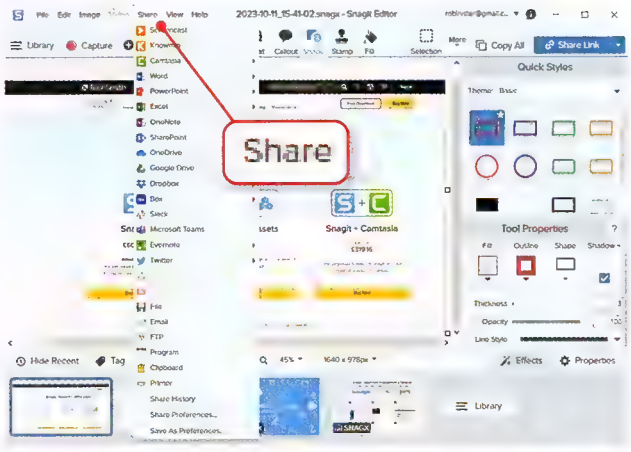


'Fake' USB sticks, which don't offer anywhere near as much storage as they claim, have flooded online marketplaces such as Amazon and eBay. These devices typically have capacities of 64GB rather than the one or two terabytes they promise, which means any files you save above that amount will not be stored. ValiDrive exposes fraudulent USB drives by performing a quick check of the device's declared storage space, and verifying whether it can successfully store data in every sector. Validated sectors are shown as green blocks (see screenshot), while those with no storage are indicated in red. The tool can also detect read and write access errors, in case your memory stick has become corrupted – or already was when you bought it. The developer tested ValiDrive on 12 USB drives from Amazon, and found they were all well under the stated capacity.

"These devices typically have capacities of 64GB rather than the one or two terabytes they promise, which means any files you save above that amount will not be stored."

Should I pay for?

Choose the right version of software



"The screen-capture element of the program is quite simple, with one-click options for capturing images and videos, but we found the Snagit Editor annoying."

Snagit 2024

WEB www.techsmith.com/store/snagit **PRICE** $106.84 Free trial period: 15 days
NEEDS Windows 10 or 11, or macOS

Snagit was one of the first tools for taking screenshots, dating all the way back to 1990. Over the years, it's added plenty of features, but has also significantly increased in price and no longer offers a free version.

With a download size of over 510MB and a slow installation process, Snagit 2024 feels bloated from the off, and you need to register with developer TechSmith just for the 15-day free trial. The screen-capture element of the program is quite simple, with one-click options for capturing images and videos, but we found the Snagit Editor annoying.

This keeps displaying pop-up messages asking how you intend to use Snagit, which are supposed to help you get started but actually prevent you from doing so. The new Quick Styles sidebar which invites you to choose a theme for recording instructional videos – complete with colourful arrows, shapes and speech bubbles – is irrelevant for other tasks, though you can hide it if it proves distracting.

Snagit's many tools are organised into logical menus, including Share (see screenshot), which lets you export your screen captures to various online services. We also like that it displays your recent screen grabs along the bottom of the main window and gives you the option to combine captured images into one video.

However, Snagit offers few tools you won't find in the free open-source program ShareX (**getsharex.com**), which – like Snagit – also now lets you record audio.

OUR VERDICT: DON'T PAY FOR IT

Snagit seems unsure whether it's aimed at screen-capture beginners (as its excessive hand-holding implies) or business professionals (as suggested by its steep price). Save your money by installing ShareX or PicPick (**picpick.app/en**) instead. ■

PRICE Free (IAP, $36.99 a year or $5.99 a month) **WEB** binaryformations.com | **NEEDS** macOS 11.1 or later, iOS/iPadOS 14 or later

You can add a comprehensive amount of detail about your belongings.

Under My Roof

Catalogue your household belongings and more.

Under My Roof is a household property database that's free to download, but limited to indexing 10 items. You can remove this limitation with a yearly or monthly subscription (if you cancel, you can still access inventory you've already added). It's available for Mac, iPad and iPhone, with your details syncing over iCloud and a single subscription covering the app on all platforms.

As you'd expect, you can index your household possessions, recording information such as make, model, price, condition, quantity, location and more. You can add a photograph of the item in question, and usefully, you can also include pictures of the purchase receipt and/or warranty information, and attach documents such as electronic instruction manuals. As well as your household contents, you can also index your house itself, including details such as its purchase date and price, square footage, the year it was built and more. You can even record routine maintenance and have the app notify you when regular checks or repairs are due. Under My Roof is nothing if not comprehensive.

It's attractive too. Individual cards are clear and well laid-out, and can be sorted into rooms if you wish. The interface is attractive, clear and Mac-like, and when you buy new items (or if you still have the box) you can bypass much of the typing by simply scanning the barcode with your iPhone. You can also use your mobile device's camera to scan paper documents such as contracts and rental agreements. As a functioning app, we've little here to criticise at all. Maybe the search function could be a little better tuned, but that should improve over time.

We do have a couple of reservations though. Firstly, did it really have to be sold using a subscription model? As a straight purchase it would be worth $25-35 of anyone's money, but do we want to pay a monthly or yearly fee for a database that we come back to far less often after initial population?

Also, are you going to have the discipline to make the best use of it? We all have good intentions, especially after moving house, but building and maintaining an inventory takes time. Are you going to keep it up to date, adding new products and purchases as you make them? Or is your enthusiasm likely to whither before you've even finished indexing your house, with the app falling into disuse but still costing you a subscription fee as you forget to cancel?

If Under My Roof sounds useful and you're confident you can update it often enough to make it worthwhile, you won't be disappointed. But if you're not sure you can go the distance, maybe subscribe for a month or two and set a Calendar alert to remind you to unsubscribe if it's no longer used. ■

> "Usefully, you can also include pictures of the purchase receipt and/or warranty information, and attach documents such as electronic instruction manuals."

VERDICT

★★★★½

A solid, attractive app that might be too much like hard work to justify a subscription. **Ian Osborne**

DEVELOPER The Tails Project **WEB** tails.net **LICENCE** GNU GPLv3

Tails 5.18

Shunting all his traffic through the darknet, we're not sure whether this Nate Drake is real...

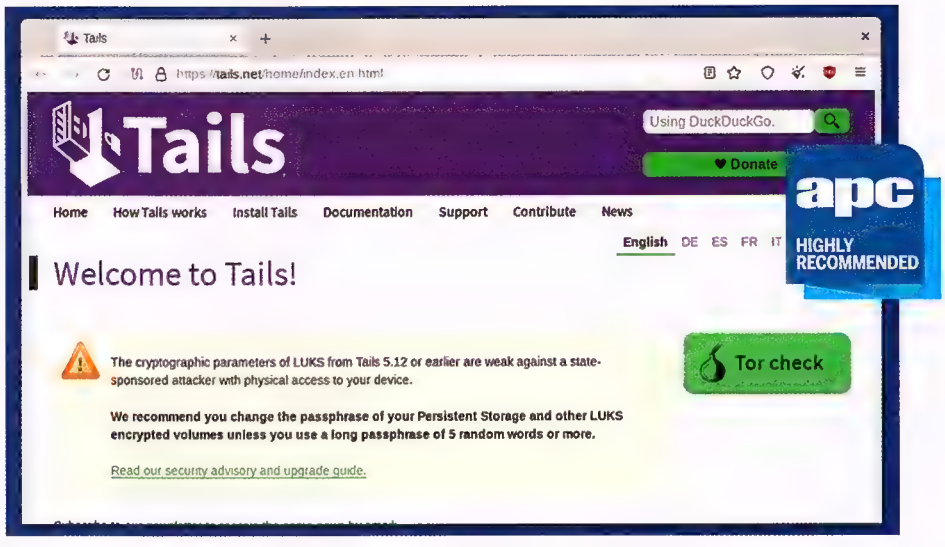
Tails (The Amnesic Incognito Live System) is a Debian-based security-focused Linux distro. Although its creators are keen to stress that there's no such thing as complete anonymity online, Tails can come very close if used properly.

Tails is a live OS designed to be booted from a DVD or USB stick. This means it runs entirely in RAM, which in theory means there's no digital footprint left on the machine once you've finished using it. Upon shutdown, the OS even overwrites most of the used RAM data to prevent it being recovered through a cold boot attack.

Naturally, this works both ways, in that you also can't save any downloaded files, bookmarks or Wi-Fi password in live mode, which is why during initial setup, Tails offers to create a persistent storage partition if you're booting from a USB stick using LUKS. Needless to say, this is only as secure as the passphrase you assign.

If you want to install Tails to a USB stick, as of version 5.17, the Tails installer is now named Tails Cloner and can be used to copy an ISO or an existing Tails installation to a flash drive. Aside from leaving no trace in live mode, the other string in Tails bow is that all internet connections are routed through the Tor network. When you first launch Tails, it offers you the choice to connect directly to Tor. Alternatively, you can do so via a bridge, which is useful in countries where using the darknet is restricted.

The main advantage of doing it this way is that using standalone apps, such as the Tor Browser, alongside other programs that connect to the internet directly, risks revealing your real IP address.


Tails
https://tails.net/home/index.en.html
Tails
Using DuckDuckGo
Donate
Home
How Tails works
Install Tails
Documentation
Support
Contribute
News
English DE ES FR IT
Welcome to Tails!
The cryptographic parameters of LUKS from Tails 5.12 or earlier are weak against a state-sponsored attacker with physical access to your device.
We recommend you change the passphrase of your Persistent Storage and other LUKS encrypted volumes unless you use a long passphrase of 5 random words or more.
Read our security advisory and upgrade guide.
Tor check
apc
HIGHLY RECOMMENDED

The Tails homepage provides key information about security updates. Keep the OS up to date and use persistent storage sparingly.

The Tails Project has gone to some lengths to make sure the bundled software is actually useful to generic users, including handy apps such as Mozilla Thunderbird (102.15.1), the GIMP image editor (2.10.22) and the LibreOffice suite (7.0.4.2).

This version of Tails (5.18) is based on Debian 12.1 Bookworm, which means programs are selected for stability rather than being bleeding-edge. It also means it uses the same version of the Linux kernel (6.1.0-12).

Web browsing is handled by the Tor Browser, which has now been updated to version 12.5.6 and includes some critical security updates. At the time of writing, however, the most recent version of the browser is 13.0, based on Firefox ESR 115. We hope this will be bundled with future Tails releases, as it includes updates such as better accessibility features. Tor itself has also been upgraded to version 0.4.8.6.

There's a lot of online debate over how much anonymity Tor truly offers. There have been examples of its privacy being compromised through methods such as poisoned exit nodes and zero-day vulnerabilities. Security vulnerabilities are regularly discovered in Tails but the project is quite candid about this and has a dedicated page explaining that neither the OS nor Tor itself are "magic" (**https://tails.net/doc/about/warnings/index.en.html**). This is just one example of Tails's excellent online documentation, which you can access via a desktop shortcut.

Tails also includes Metadata Cleaner, which uses the mat2 toolkit to remove personal information from files you send over the web.

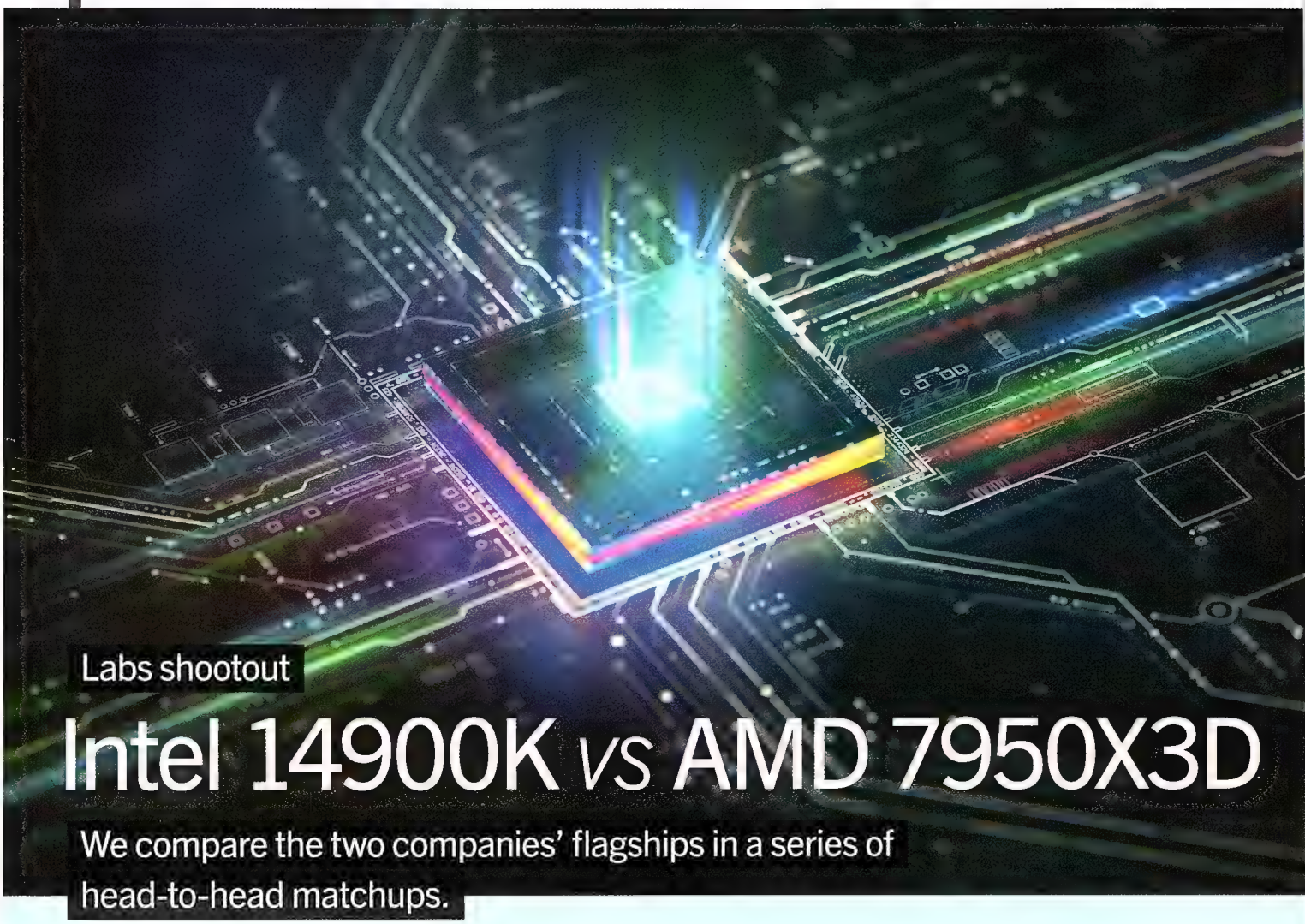
In summary, if you have placed your faith in the darknet for staying anonymous online, Tails can offer much better anonymity than just installing the Tor Browser on your go-to Linux distro. ■

"If you want to install Tails to a USB stick, as of version 5.17, the Tails installer is now named Tails Cloner and can be used to copy an ISO or an existing Tails installation to a flash drive."

VERDICT

★★★★☆

Offers excellent online anonymity, especially in live mode. It's simple to configure Tor bridges. Documentation is very good. **Nate Drake**



Labs shootout

Intel 14900K *vs* AMD 7950X3D

We compare the two companies' flagships in a series of head-to-head matchups.

If you're building the ultimate gaming rig, you'll want to know the answer to this question: What is the best gaming processor you can buy? Is it the AMD Ryzen 9 7950X3D or the Intel Core i7 14900K? We're here to answer that question.

Both processors have their strengths and weaknesses, and both go about things in different ways. The 14900K goes for the brute force approach, offering clock speeds as high as 6.0GHz. Other things being equal, a higher clock speed means higher performance. The problem with the 14900K is that it runs hot and requires a lot of power when presented with a full load.

AMD's flagship incorporates stacked V-Cache, offering 128MB of on-chip level 3 cache compared to the 14900K's 32MB. That means more data can be stored 'close to the metal'. In games that benefit from low latency and fewer relatively slow memory accesses, this approach is a good one. However, the 7950X3D only includes V-cache on one of its two dies, and its lower clock speeds in comparison with the standard 7950X can hamper it under non-gaming workloads.

While both AMD and Intel promote their top chips as the ultimate gaming CPUs, there are other options that are essentially as good when used with anything less than a high end graphics card. The Ryzen 7 7800X3D and Core i5 14600K are both more than capable gaming chips in their own right, though they don't offer the kind of all round single and multi threaded performance on offer from the top chips.

Before getting into it, a few notes on testing methodology. We decided to adopt a real world testing approach. A high end gaming system is unlikely to be paired with a 1080p screen. There are exceptions, such as if you're looking to push hundreds of FPS in competitive shooters, but in most cases, a card like the RTX 4090 that we're using here is overkill for 1080p.

2560 x 1440 is my starting resolution. As high refresh rate 1440p monitors become more prevalent, there's still a need for a fast CPU to keep average frame rates in the 100 FPS+ range and raise 1% lows. So, with that in mind, I have run a series of benchmarks at 1440p with both high and low graphics settings. At high settings, you get a real world set of results, while the low detail benchmarks provide a better contrast between both CPUs.

I've thrown in a set of high detail results at 4K too. That's where a card like the RTX 4090 is at home. If you're fortunate to be gaming with an RTX 4090, it's likely you own a high refresh rate 1440p or 4K gaming monitor and play games with eye candy and ray tracing effects turned on. I can't imagine too many users will choose to game at 4K with low details over 1440p at high details, so I did not run 4K benchmarks at low graphics settings.

So, to boil it down. Clocks or cache? Which is better? We've run both chips through their paces looking at gaming with both high and low graphics settings along with a few system benchmarks and some power and temperature comparisons.

Neither chip is a bad choice, but there can only be one winner.

© Getty

Intel Core i9 14900K

The best, last and most demanding CPU of the LGA 1700 generation.

The Intel Core i9 14900K is essentially an i9 13900K with higher clock speeds. It's a 24-core/32-thread processor, made up of eight Performance-cores (P-cores) and 16 Efficient-cores (E-cores). It includes a total of 32MB of L2 cache. Each of the eight P-cores has 2MB each, with the four E-core clusters having access to a shared 4MB.

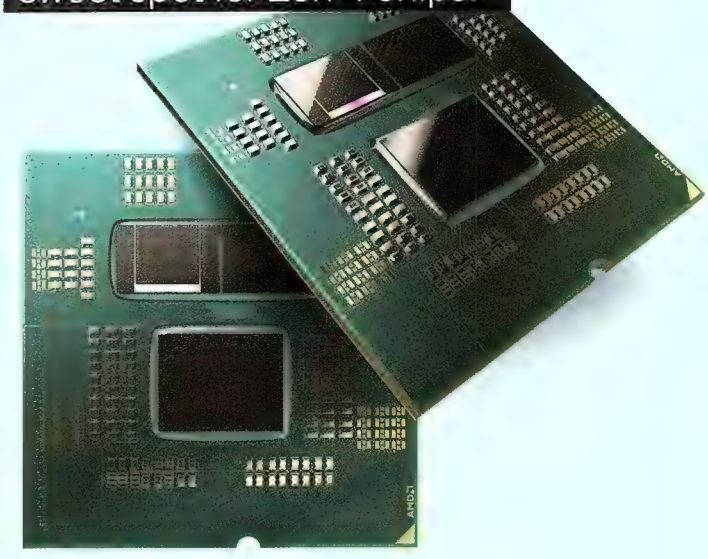
The 36MB of shared L3 cache is accessed via an internal ring bus which now runs at 5.0GHz. The 14900K's official memory support has increased to DDR5-5600, but as you'll probably know, the 14900K unofficially supports speeds much higher than this. The latest Z790 refresh motherboards are capable of speeds of over 8000MHz. The 14900K does continue to support DDR4 memory but this will be the last generation to do so.

In order to promote the 14900K as its fastest CPU, Intel has had to push the limits of the Intel 7 process. It's capable of boosting its P-cores as high as 6.0GHz when power and thermal conditions allow, while the E-cores can reach up to 4.4GHz. Essentially it's a slightly overclocked i9 13900KS.

Like all overclocked processors, chucking more power at a chip delivers diminishing returns. To reach its high frequencies, the 14900K can consume over 300W with its limits removed. That applies to pretty much every enthusiast tier motherboard! 300W+ means there's a lot of waste heat. Even a 360mm AIO liquid cooler is barely able to tame a 14900K when it's fully loaded.

"The 14900K's official memory support has increased to DDR5-5600, but as you'll probably know, the 14900K unofficially supports speeds much higher than this."

"It officially supports DDR5-5200 memory, though DDR5-6000 or a little above remains the performance sweet spot for Zen 4 chips."



AMD Ryzen 9 7950X3D

Cache and efficiency over brute force. But is it enough?

The AMD Ryzen 9 7950X3D is fundamentally the same as the 7950X with the addition of the 64MB of V-Cache and some power and clock speed adjustments. It's a Zen 4 chiplet based design, with dual 8-core Core Complex Dies (CCDs) and a shared I/O die. It officially supports DDR5-5200 memory, though DDR5-6000 or a little above remains the performance sweet spot for Zen 4 chips. The latest BIOS' of 600-series motherboards are able to support much higher speeds, though running a very fast kit requires dropping the memory controller clock to a lower speed, which costs a lot of performance.

Whereas the 7950X includes 32MB per CCD for a total of 64MB, the 7950X3D comes with an extra 64MB for a total of 128MB. However, only one CCD comes with stacked cache. AMD says this is for cost and diminishing return reasons. This approach leaves one CCD free to clock to higher levels and the other with the gaming friendly V-cache. It requires software awareness to benefit fully.

The 7950X3D is downclocked compared to the 7950X, but not by all that much. Its base clock is 4.2GHz, lower than the 4.5GHz of the 7950X, yet the boost clock remains the same at 5.7GHz. That leaves the 7950X3D in a kind of neither here nor there situation. Its gaming performance is hardly better than the 7800X3D, while the lower clock speeds compared to the 7950X can lead to lower productivity performance under fully loaded conditions.

There is an upside. Lowered all core clocks mean AMD was able to drop the TDP of the 7950X3D to just 120W vs the 170W of the 7950X. This means the 7950X3D is stunningly power efficient and much easier to cool than its Intel competitor. That counts for a lot.

Benchmarks galore

Let the number speak the truth.

1440p low detail

Let's begin with the 1440p low detail results. We get a good look at how some games respond well to AMD's 3D V-cache. *F1 21* is a case in point. *Metro Exodus* is another one that surprisingly favours the 7950X3D, while *Far Cry 6* and particularly *Ghost Recon Breakpoint* are two that run better on the Intel chip. Some demanding games like *Cyberpunk 2077* still ask a lot of the RTX 4090, In which case the CPU is less relevant.

Based on these few results I'd give the win to the 7950X3D, if only because of its power efficiency and lower cooling requirements. Either chip will give you excellent gaming performance.

Winner: **AMD Ryzen 9 950X3D**

1440p high detail

At 1440p with higher detail settings, the results close up as the load shifts back to the graphics card. *F1 21* still favors the 7950X3D, while *Ghost Recon Breakpoint* favours the 14900K. The others are mostly within a margin of error. Let's call this one a tie.

Winner: **Tie!**

4K

At 4K with high graphical settings, the 7950X3D and 14900K close up even more. *F1 21* and *Ghost Recon Breakpoint* still perform better on the 7950X3D and 14900K respectively, but the other results are basically tied.

Once again, neither chip is a slouch when it comes to high detail gaming, but given the power advantage of the 7950X3D, it'd give this one to AMD by a hair. Gaming isn't the only use for a high end CPU though...

The high frequencies and consistently high performance of the 14900K leave it superior to the 7950X3D in productivity applications. Encoding tests tend to favor the 14900K too. Intel wins this round.

Winner: **Intel Core i9 14900K**

Power & temps

Finally we come to a look at power and temperature results. There's a lot of noise around the 14900K and its high power consumption and the resulting need for a high end cooler to keep it from throttling. When you load it up fully, that is definitely the case, but under gaming loads, the 14900K is a lot more power efficient than all those peak power consumption tests you'll come across would suggest. Still, the 7950X3D is the more power efficient of the two chips.

You'd expect the temperature results to heavily favour AMD, but they really don't. AMD's Zen 4 chips can get hot, and although AMD says this behavior is expected, you can't ignore the need for a capable cooler.

So, even though the 14900K is far less of a nuclear reactor under gaming conditions, the 7950X3D is still more power efficient. A win to AMD here.

Winner: **AMD Ryzen 9 950X3D**

So, which is the better chip?

Both CPUs are capable gamers. We narrowly give the win to the 7950X3D for pure gaming but only by account of its superior power efficiency.

But there's more to a CPU than just gaming. The 14900K is superior in productivity tests, and its idle and gaming power consumption is much better than its stratospheric peak load numbers would suggest. Power consumption aside, the 14900K is the better all round CPU. It's also more affordable.

In conclusion, the 14900K is an excellent all round performer, but at the cost of power efficiency. The 7950X3D is a capable and efficient gaming chip, but isn't the all round wonder chip we'd like it to be. Your own needs, wants and use cases will determine which one is more suitable for your build.

But there can only be one winner. The overall win goes to the Intel Core i9 14900K by a nose, but if you value power efficiency highly, then the 7950X3D is a solid choice.

Winner: **Intel Core i9 14900K**

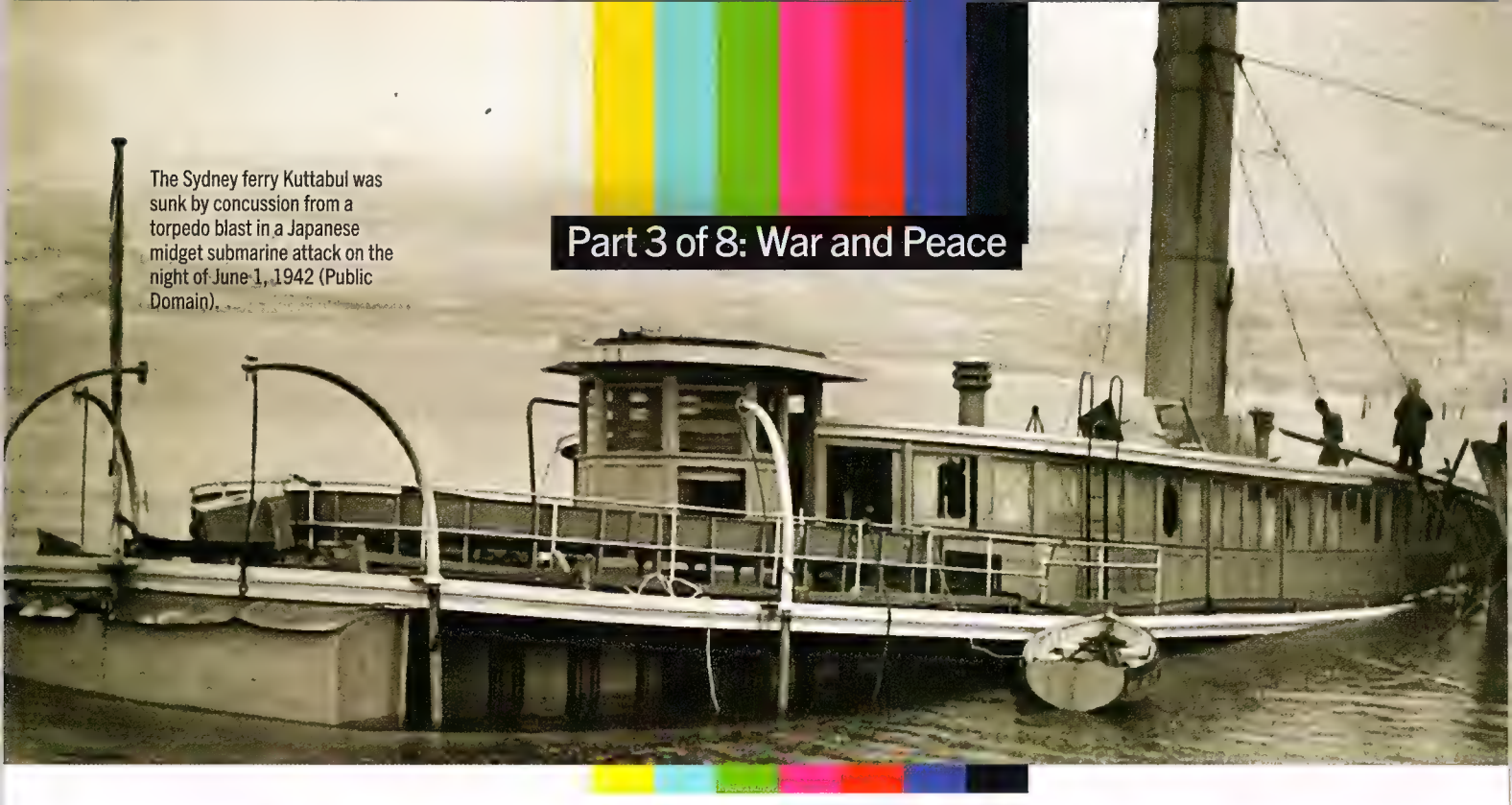
"Neither chip is a slouch when it comes to high detail gaming, but given the power advantage of the 7950X3D, it'd give this one to AMD by a hair. Gaming isn't the only use for a high end CPU though..."

How do they compare?

		AMD Ryzen 9 7950X3D	Intel Core i9 14900K
Handbrake 1.6	Video conversion 4K to 1080p FPS	117	149
Cinebench R23	Rendering - Multi thread Score	35,384	40,214
Cinebench R23	Rendering - Single thread Score	2,054	2,254
Blender 3.6 Whitelands	Render Time (seconds) Lower is better	425	377
7Zip 22.01	File Compression - Billion Instructions per second	210.11	200.76
PCMark 10	Extended Score	13,883	13,753
3DMark TimeSpy Extreme	Overall score	17,813	18,389
	CPU Score	11,815	13,540
	GPU score	19566	19630
3DMark Port Royal		25,958	25,868
Power and Temperatures			
Power consumption 3x Metro Exodus (high preset)	Peak power (w)	81	151
	Average power (w)	72	101
Power consumption 3x Metro Exodus (Extreme preset)	Peak power (w)	68	153
	Average power (w)	64	94
Thermal Performance 3x Metro Exodus (high preset)	Peak temperature (c)	66	82
	Average temperature (c)	63	58
Thermal Performance 3x Metro Exodus (Extreme preset)	Peak temperature (c)	64	81
	Average temperature (c)	55	56
1440p low details			
Cyberpunk 2077	1440p, Low, Avg FPS	241	239
	1440p, Low, Min FPS	145	170
F1 2021	1440p, Low, Avg FPS	494	459
	1440p, Low, Min FPS	359	315
Far Cry 6	1440p, Low, Avg FPS	195	216
	1440p, Low, Min FPS	157	187
Ghost Recon Breakpoint	1440p, Low, Avg FPS	212	254
	1440p, Low, Min FPS	103	116
Metro Exodus Enhanced	1440p, High, Avg FPS	172	156
	1440p, Ultra, Low, Min FPS	116	107
Red Dead Redemption	1440p, Low, Avg FPS	218	202
	1440p, Low, Min FPS	81	58
Total War: Warhammer III	1440p, Low, Avg FPS	422	446
	1440p, Low, Min FPS	378	370

"The 14900K is an excellent all round performer, but at the cost of power efficiency. The 7950X3D is a capable and efficient gaming chip, but isn't the all round wonder chip we'd like it to be."

		AMD Ryzen 9 7950X3D	Intel Core i9 14900K
1440p high details			
Cyberpunk 2077	1440p, RT Ultra, Avg FPS	80	79
	1440p, RT Ultra, Min FPS	64	63
F1 2021	1440p, Ultra w/ RT, Avg FPS	241	205
	1440p, Ultra w/RT, Min FPS	155	161
Far Cry 6	1440p, Ultra w/ RT, Avg FPS	146	145
	1440p, Ultra w/RT, Min FPS	112	118
Ghost Recon Breakpoint	1440p, Ultimate, Avg FPS	158	175
	1440p, Ultimate, Min FPS	80	95
Metro Exodus Enhanced	1440p, Extreme, Avg FPS	126	125
	1440p, Extreme, Min FPS	78	77
Red Dead Redemption	1440p, High, Avg FPS	184	186
	1440p, High, Min FPS	49	46
Total War: Warhammer III	1440p, Ultra, Avg FPS	183	178
	1440p, Ultra, Min FPS	147	138
4K high details			
Cyberpunk 2077	1440p, RT Ultra, Avg FPS	41	41
	1440p, RT Ultra, Min FPS	35	34
F1 2021	1440p, Ultra w/ RT, Avg FPS	184	163
	1440p, Ultra w/RT, Min FPS	156	138
Far Cry 6	1440p, Ultra w/ RT, Avg FPS	117	115
	1440p, Ultra w/RT, Min FPS	107	104
Ghost Recon Breakpoint	1440p, Ultimate, Avg FPS	116	123
	1440p, Ultimate, Min FPS	64	75
Metro Exodus Enhanced	1440p, Extreme, Avg FPS	77	77
	1440p, Extreme, Min FPS	54	54
Red Dead Redemption	1440p, High, Avg FPS	127	128
	1440p, High, Min FPS	43	45
Total War: Warhammer III	1440p, Ultra, Avg FPS	103	102
	1440p, Ultra, Min FPS	82	79



The Sydney ferry Kuttabul was sunk by concussion from a torpedo blast in a Japanese midget submarine attack on the night of June 1, 1942 (Public Domain).

Part 3 of 8: War and Peace

A Vision to Behold: The Story of Electronic Displays

The 1940s began with a world war and finished with the world still trying to recover. Yet, in times of war, sadly, technology advances are almost universally at their most rapid. Darren Yates writes.

The new decade is barely six weeks old when Australian scientist Professor (later Sir) Mark Oliphant is involved in development of one of the greatest inventions of the war, the cavity magnetron. It revolutionises radar, thanks to its production of 10cm radio-waves and delivers a quantum-change in radar-image resolution. TV engineer Alan Blumlein and others take the cavity magnetron and by 1942, indicator lines and points on a cathode-ray tube begin to display terrain and map-like images from the air. What's more, while Blumlein's contribution in British television went 'lights-out' for the duration of the war, television itself would still have one more vital 'defensive' role to play.

The Battle of the Beams

Even early in the war, radio played a role well beyond communication. Radio-navigation aids, such as the Lorenz blind-landing radio receivers, were in use since 1937 to help navigate pilots toward a safe landing during poor weather.

Using tightly-directed beams of Morse-code 'dots' and 'dashes', pilots weaved towards the 'equi-signal' of the two beams to be sure of a correct approach to the runway.

By 1940, the German Luftwaffe redesigned the Lorenz system into navigation aids for their bombers. One of the systems employed was known as 'Y-Gerat' or 'Wotan' (see the excellent 1977 BBC Series 'The Secret War' – Part 1). It featured a single beam that enabled a ground-controller to determine the target-distance from an aircraft by the phase-change of the radio signal being re-radiated back.

The problem for the Nazis was the transmission frequency they adopted for Y-Gerat was 45MHz, which just happened to be the frequency of the dormant BBC television transmitter at Alexandra Palace. British scientists responded by cranking up the transmitter, redirecting false signals and corrupting the system. Not long after, the Luftwaffe gave up and their attention turned towards Russia.

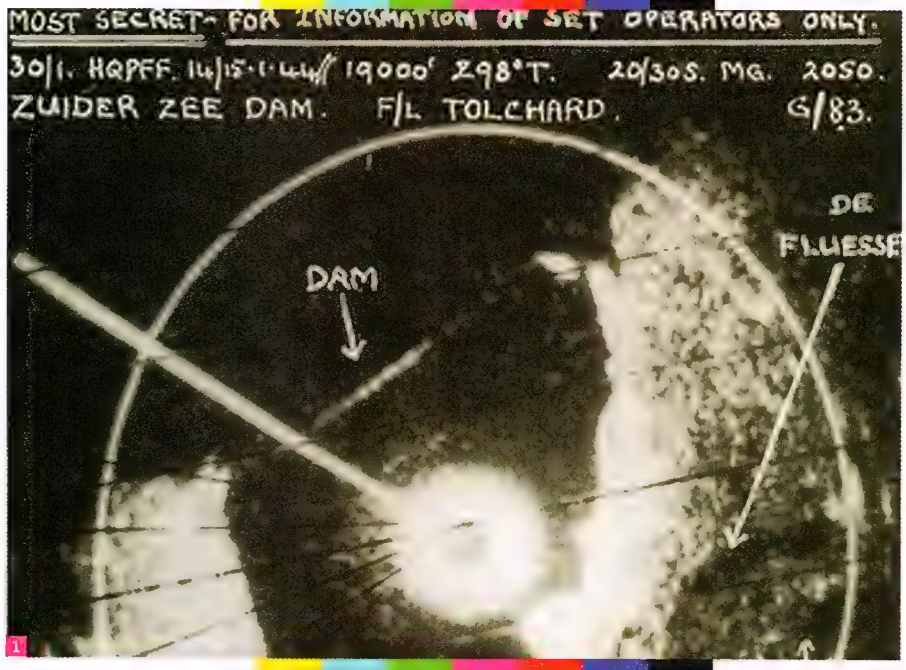
High-definition television in the U.S.

Meanwhile, the U.S., unencumbered by war, continued developing television technology and in 1941, the National Television Standards Committee (NTSC) settled on a TV resolution of 525 lines at 30 frames per second – at the time, the highest resolution in the world. What's more, commercial television was green-lit for July 1, 1941. However, events in December would soon plunge the U.S. into war and by April 1942, television construction was halted until after the war.

One week in June

It's almost a universal truth that wars accelerate technological development, as much as they do the timelines of major events. In almost any week of WWII, you could identify key events and actions that in some way shaped the outcome of the war (and, in some cases, the peace afterwards). One such week was the first week of June, 1942.

It had just ticked over 8pm on May 31 when the 'indicator loop' submarine detection coils at the entrance of Sydney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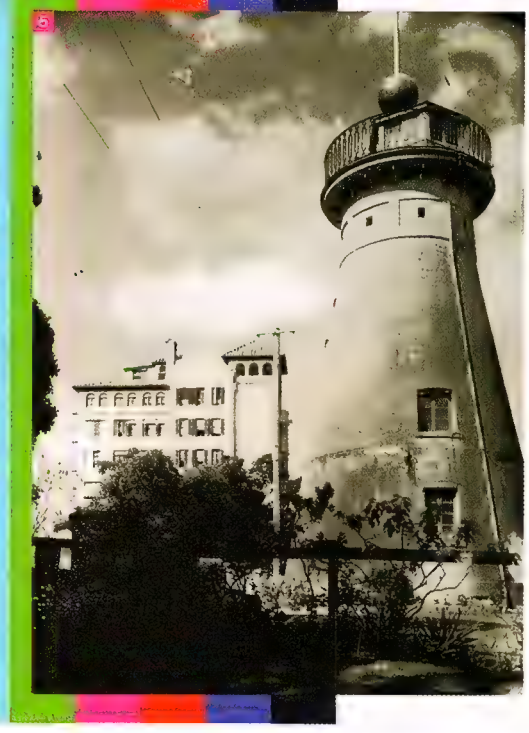
1 A PPI plot of the Zuiderzee, flying over the Netherlands and captured by a radar operator during WWII using Blumlein's H2S radar (Public Domain).
2 Actress, rally-car driver and pilot Paddy Naismith was the first person transmitted by all-electronic 'Telechrome' colour television in 1941 (Public Domain).
3 A Japanese midget submarine is recovered from Sydney Harbour, June 1, 1942 (Public Domain).
4 Originally designed in the British lab of Australian scientist Mark Oliphant, this WWII-era cavity magnetron was made in the U.S. (Public Domain).
5 The old observatory on Wickham Terrace, Brisbane, the site of Australia's first licensed TV transmissions in 1934 (Image credit: State Library of Queensland).



Heads picked up the small but tell-tale sign of an underwater passage into the harbour. However, due to other traffic at the time, it wasn't noticed. The following morning, Sydney-siders were waking to news of a Japanese midget-submarine attack on Sydney harbour. The loss of 21 sailors billeted on the ferry 'Kuttabul', the shells fired at Rose Bay and Bellevue Hill in Sydney's east and Newcastle on the Hunter coast all brought home the reality of war to many Sydney-siders for the first time. Attacks continued up and down the coast over the following week.

Meanwhile, the bulk of the Imperial Japanese Navy was en route to its destiny at Midway Island. The subsequent loss of four Japanese aircraft carriers during the Battle of Midway on June 4 and 5, 1942 largely ended any real threat of an Australian mainland invasion by Japanese forces and marked a turning-point of the Pacific war.

Genius lost

However, as the Battle of Midway reached its conclusion, tragedy befell the British scientific community. On June 7, 1942, an RAF flight, testing new magnetron-powered airborne radar, crashed near Ross-on-Wye in the west of England, killing all on board. Sadly, the flight's chief scientist was none other than Alan Blumlein, the engineering genius who invented stereo in 1931, who gave much to Britain's world-leading high-definition television in 1936 and finally, his all to air-to-surface radar.

Blumlein wasn't a household name, except within the scientific and military communities who knew of his importance, including Prime Minister Winston Churchill and it was on Churchill's orders that Blumlein's death was kept secret until after the war. Blumlein had amassed an astonishing 128 patents during his lifetime, the last three of which were awarded after his death. He was only 38. One can only imagine what he might have invented had his life not been cut so tragically short.

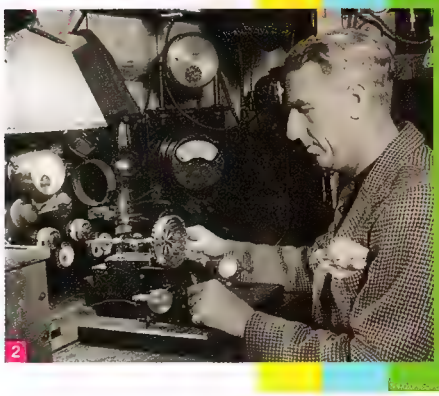
In 2019, a monument was unveiled in the field in Ross-on-Wye where the plane crashed, a memorial to the 11 men from the RAF, the Telecommunications Research Establishment and EMI who died.

To see by night

While air-to-surface radar enabled aircrews to see the ground at night and through cloud on a plan-position indicator, it wasn't just the Allies or aircrews who shared this interest in night-time viewing. Allgemeine Elektricitats-Gesellschaft was one of Germany's foremost engineering companies before WWII. Better known as 'AEG', the company pioneered the audio tape recorder during the late-1930s. It also helped usher in the new field of 'night vision' and the science of optoelectronics.

But whether they knew it or not, AEG and the U.S. giant Radio Corporation of America (RCA) were in something of a technological arms race during the 1930s to develop new technology enabling their countries' respective armed forces to see the battlefield in the dark of night using infrared light.

That technology became the 'image intensifier tube' (IIT). An IIT works by turning the few available photons of light into an electron stream. That stream hits a



1 Thomas Elliott experiments with electromechanical television in Brisbane in 1934 (Image credit: State Library of Queensland).
2 Elliott experiments were conducted at the old observatory in Wickham Terrace (Image credit: State Library of Queensland).
3 The ZG 1229 'Vampire' was an infra-red night-vision attachment for an assault-rifle used by German infantry during WWII (Public Domain).
4 An 'H2S' radar oscilloscope (round display tube) as flown during WWII (Image credit: Electrik Fanne, CC BY-SA 4.0).

positively-charged electrode called a 'microchannel plate', which causes a small cloud of electrons to be released at high speed within proximity to that point. These electrons then hit a phosphor screen plate, turn back into visible-light photons and appear as a brightened version of the original image.

However, first-generation night-vision devices weren't 'photon multipliers', but rather 'image converters'. They required a bright source of infrared light (invisible to the naked eye) and through a photocathode made from a combination of silver, oxygen and caesium, converted the infrared photons back into visible-light. The first practical night-vision device was introduced by the German army in 1943 and allowed snipers and tank commanders to see targets at night.

Television in colour

The history of television is often described in a sequence, first monochrome (black-and-white), then colour. But the reality is more complex. Monochrome television was simpler to design and build, since it required just one light source and you only had to deal with image brightness or 'luminance'. Yet from the beginning, scientists and engineers researched television in colour. For instance, John Logie Baird presented the first mechanical colour television in 1929. The first patent for colour television belongs to Armenian engineer Hovannes Adamian, which is dated March 1908!

The key issues in developing colour television were the added complexity of controlling three light sources instead of one, plus the added cost that made an already expensive appliance even more so.

Engineers knew they could generate colour images by controlling the intensity of three light sources, one each of red, green and blue. This concept was used by Baird and Bell Labs in their respective early experiments (the same basic concept still drives displays and image technology today). However, the added cost in the complexity of colour television meant even fewer could afford one.

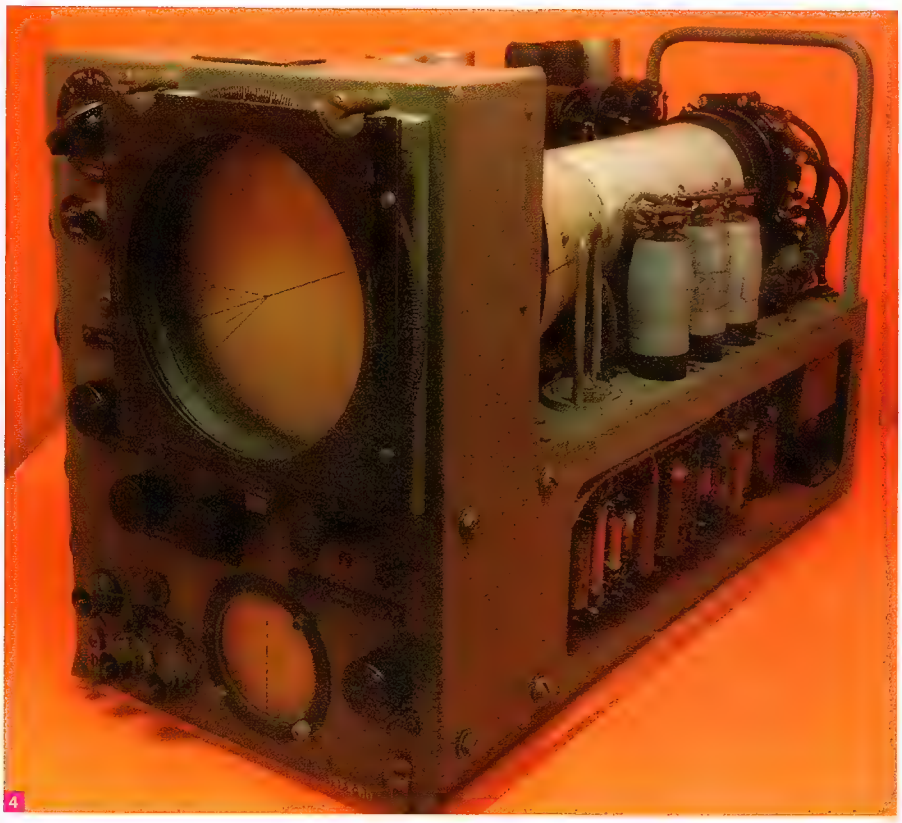
Colour television followed the same path to monochrome television, beginning as a completely mechanical process, before merging into a hybrid electro-mechanical system during the late-1930s/early-1940s. But in August 1944, John Baird demonstrated the first all-electronic colour television projection system, dubbed the 'Telechrome'. With an astonishing 600 lines of resolution, Telechrome, however, would be Baird's last contribution to television – he passed away in 1946, ending work before the system was completed.

Television returns

With the war won in 1945, the BBC began pulling its television setup out of mothballs and the first post-war transmissions resumed in June 1946, although not everyone was pleased to see it return. Some within the BBC itself questioned the merit of television and the potential risk of siphoning away audiences from radio. Moreover, concerns were raised by Robert Silvey, BBC head of 'Listener Research', that television could be a cause of change in contemporary culture...

Australia to finally get television...

But while Europe was quick to reinstate television broadcasting after the war (both Russia and France had television



broadcasting running by the end of 1945) and America had already begun testing colour television, it seemed the only country yet to see the visual revolution was us!

The first tentative steps to rectify the situation came in 1949 from then-Australian Prime Minister Ben Chifley, announcing his intention to launch a national TV service. Public demonstrations around Australia of new high-definition television in 1949 gathered huge crowds and great enthusiasm.

However, the voting public had other ideas and the Australian Labor Party lost the 1949 Federal Election later that year. Unfortunately for television, returning Prime Minister, Robert Menzies, was less enthusiastic about the effect it might have on society. In the end, Australia would have to wait well into the next decade before anyone would hear the words 'Welcome to Television'.

... but we already had TV – in 1934!

Still, the far more interesting story is the fact that, like much of the scientific world, Australia also had television before WWII – and with government blessing – as early as 1934. Today's wireless technology began as experiments that grew into the field known today as 'amateur radio', which is essentially the use of a few remaining slivers of radio-frequency spectrum by licensed radio operators for non-commercial use. Radio-amateurs communicate with others around the world using one of Morse Code, voice, video and, more recently, digital transmissions such as 'FT8', with varying ranges.

With Australia's vast distances, it was a cinch we'd take to radio-communication like ducks to water – the Wireless Institute of Australia, the national body representing local amateur-radio enthusiasts, was founded in 1910 and remains the oldest national body of its type in the world.

By the 1930s, radio-amateurs could be found across the country. What's more, in most cases, you invariably built your own transmitters and receivers (think building your own PC and apps).

It was this roll-your-own attitude that grabbed Thomas Elliott and Dr. Valentine McDowall, radio-amateurs operating the experimental radio research station 4CM out of the old observatory located on Wickham Terrace in Brisbane.

Broadcast-radio had only been operating in Brisbane since 1925 and wasn't yet a 24-hour operation. So, Elliott and McDowall would dutifully wait until the broadcast stations had closed for the day and then begin transmitting television images to all who could receive them. Not surprisingly, while the number of television enthusiasts was not huge (given you had to make your own TV), the Courier-Mail reported at the time of a dozen or so receivers within the Brisbane area, with similar numbers in Sydney and Melbourne. It's said that someone attached to the University of Melbourne had also received the transmissions (read the story at **https://trove.nla.gov.au/newspaper/article/97712066**).

Make your own television

However, while those early tests involved still images, Elliott and McDowall soon had a modified film projector setup to transmit moving images. What's even more fascinating is that the Courier-Mail ran a story by Tom Elliott on how to build your own television receiver – it even featured a circuit diagram (**https://trove.nla.gov.au/newspaper/article/97787762**). Imagine a metro-newspaper publishing a circuit diagram today? No, neither can I – what a drab existence we now lead!

The system, essentially based on Baird's (and Sutton's) electromechanical design, featured a Nipkow disk spinning at 750 revolutions per minute (rpm) – with a 30-line television image, that gave 25 frames per second and your TV picked up the transmission by tuning to a frequency of 2.198MHz.

With the growing interest transmissions were creating, the Courier-Mail reported 4CM was granted the first television-broadcast license in Queensland by the Australian government in July 1934. By March 1935, Elliott and others were closely following the EMI/Baird battle in London from afar, declaring television ready for practical use in Australia and calling on governments to get moving.

Sadly, by 1936, enthusiasm for local television was dampened by reports from travellers to London, who considered what they saw there not yet ready for prime-time, despite a Royal Commission previously countering otherwise (**https://trove.nla.gov.au/newspaper/article/36777916**, see last month).

An unaffordable luxury

Despite various efforts, the Australian government firmly nailed shut any idea of local television in March 1939. The Postmaster-General, A.G. Cameron, in charge of all radio communications, stated that in his view, television was 'an experimental luxury which Australia could not at present afford'.

And that was that. WWII was declared less than six months later and Cameron was proved correct – we could barely meet the war-time electronics-production requirements of our armed forces, let alone start pushing television as well. But TV's day would come. ■

Next time

Next time, we drive-by the 1950s and 60s – and Australia finally gets national TV. Meanwhile, television broadcasts overseas expand into colour, a new technology transforms television into the 20th century's entertainment powerhouse and the first technological steps are made towards a new generation of visual display beyond cathode-ray tubes. *See you then.*

HOW YOU'RE MOST LIKELY TO BE

HACKED/ SCAMMED/ INFECTED IN 2024

Nik Rawlinson explores how to protect yourself from the most common attacks and exploits.

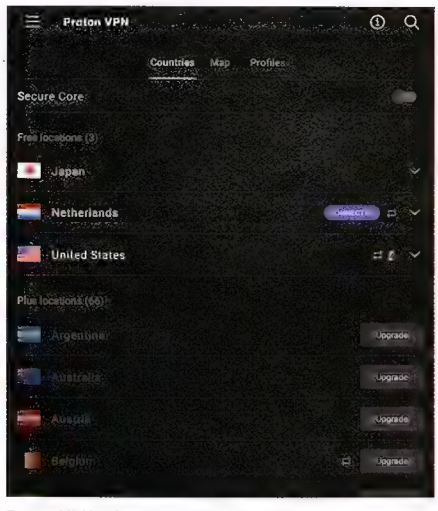
It might be a while since you last experienced a major malware attack – but the threat hasn't gone away. Cybersecurity specialist SonicWall reports that there were more than 5.5 billion malware attacks recorded in 2022. And simply keeping your security software up to date may not keep you safe: cloud solutions provider Mimecast found that more than 90% of successful hacking attacks are now enabled not by traditional malware, but by someone unwittingly clicking on a phishing email.

If you want to minimise your risks, you need to recognise the biggest threats, and know how to avoid them – whether that's via your computer, your mobile devices, your website or your smart devices.

Your computer

If it seems like the days of major virus outbreaks are behind us, that's because operating systems have got much better at blocking this type of threat. Windows and macOS both have built-in safeguards to prevent applications from performing dangerous actions such as meddling with your system settings and replicating themselves – at least without your permission. This is what's happening when Windows asks "Do you want to allow this app to make changes to your device?"

However, the effectiveness of these safeguards depends on the user paying attention, and not reflexively clicking "Yes" on apps they don't know to be trustworthy. If you've downloaded an installer from an official store or the original manufacturer, the risk may be minimal, but if you get apps from sketchier sites – or via BitTorrent – they could be bundled with a malicious payload. At its most benign, this might be some unwanted utility or browser toolbar; at the opposite end of the scale, it could be a Trojan or even ransomware.



ProtonVPN's free tier is ideal for a single device.

However, while installing untrusted downloads is a sure way to compromise your own security, it's not the most common. Hackers and other malicious actors increasingly take a sneakier approach: in 2021, three-quarters of hackers said that traditional firewall and antivirus protections were obsolete in an age when they could instead use social engineering to gain access to privileged accounts.

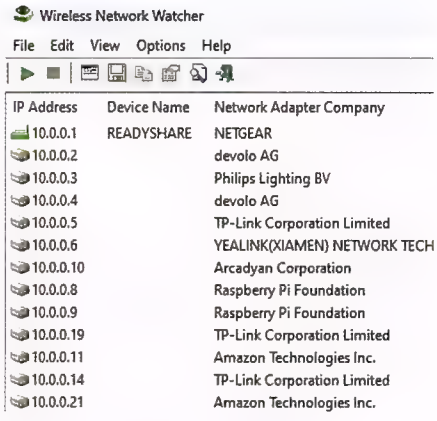
Verizon's 2023 Data Breach Investigations Report found that 74% of breaches "involved the human element, which includes social engineering attacks", and that 79% of businesses and 83% of charities had experienced phishing attacks over the previous 12 months. By contrast, viruses, spyware and malware accounted for just 11% of business-focused attacks and 9% of attacks on charities, while ransomware affected 4% in each category.

Your best defence, therefore, isn't technical but mental: you need to be suspicious of anything that arrives by email, and very wary of sharing personal information that could be exploited. You might also choose to use a VPN to encrypt your communications: this won't prevent you from inadvertently entering sensitive information into a phishing site, but it will block snoopers from spying on your network traffic or your Wi-Fi connection.

KEEP YOUR COMPUTER SAFE
Be alert to social engineering and phishing attacks
Employ multiple lines of defence, including a VPN
Keep watch for unfamiliar devices on your home and business network

There are lots of VPNs to choose from; our A-List pick NordVPN (**nordvpn.com**) costs $107.73 for two years, but if that's too much for you, our second choice ProtonVPN has a free tier (**protonvpn.com/free-vpn**), which can be used with a single device connecting through servers in the Netherlands, US and Japan. Both NordVPN and ProtonVPN maintain a no-logs policy, and they're based in jurisdictions that further protect your privacy (Panama and Switzerland respectively). Opera also offers a free VPN service for in-browser use (**opera.com/features/free-vpn**).

There are plenty of other VPN services to choose from, but treat unfamiliar brands with scepticism: all of your network traffic will be passing through their servers as you browse and work online, so it's essential that you trust them and understand what they're doing with your data.



Wireless Network Watcher can log and list your network devices.

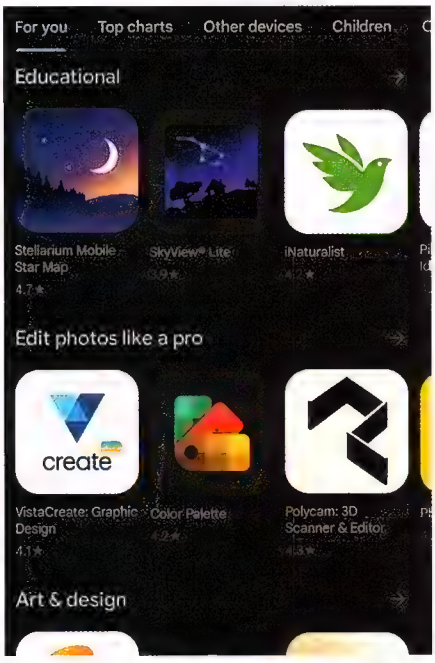
Depending on your network hardware, it may be possible to set up a VPN on your router. This protects every device in your home, without your having to configure each machine individually. However, the VPN can impact on your connection speed – and remember that once you take your phone or laptop outside of your home network, it will no longer be protected.

Another network-oriented measure you can take is to keep an eye out for unfamiliar or unauthorised devices – in truth this is an unlikely avenue of attack, but if a rogue device gets onto your LAN it could harvest data for nefarious purposes, or distribute malware across your devices. An app such as Wireless Network Watcher can alert you to the arrival of new clients on your network, and your router will normally allow you to block any devices you don't recognise.

Your mobile devices

Smartphones hold a significant quantity of personal data. Many of us use them as payment devices, they can track our movements, and they have access to our contacts, texts, photos and emails. This makes them a prime target for attack.

The most common way in which smartphones and tablets get compromised is via dodgy software installed from outside of the official app stores. In 2016, the European Union Agency for Cybersecurity (ENISA)



Downloading from official app stores gives you extra protection.

warned that users should avoid third-party sources to minimise the risk of installing a malicious application; the following year, the US Department of Homeland Security issued a report affirming that "users should avoid (and enterprises should prohibit on their devices) sideloading of apps and the use of unauthorised app stores".

To be fair, sideloading doesn't always have to be problematic – both Apple and Google permit large companies to distribute their own in-house apps on company devices, but this requires special corporate configuration and managed accounts.

For individuals, sticking to the official stores lets you avoid a lot of bad stuff. In 2020, Apple removed or rejected close to a million apps and updates from its App Store; almost a quarter were found to be violating privacy guidelines, while more than 150,000 were banned for being spam, copycat applications or misleading users. Apple also expelled 470,000 teams from its developer programme for fraud-related reasons, and rejected 205,000 enrolment attempts, again over fraud concerns.

Historically Google hasn't been quite so strict about what gets into the Play Store, but the tech giant has recently stepped up its efforts to crack down on malware, and its Google Play Protect technology automatically scans apps for potentially malicious behaviour. "Play Protect can't keep all malware off of Android phones," noted security consultant Joel Snyder, writing for Samsung, "but the risk is much higher when users install apps from the internet or hacker-specific app stores. For this reason, most Bring Your Own Device (BYOD) and Choose Your Own Device (CYOD) policies prohibit sideloading."

Even with these safeguards in place, you should still check the reputations of the apps you download, and be cautious about anything unfamiliar. Researchers at VPN Check last year found that 84 potentially deceptive apps remained on sale through Apple's App Store, 12 months after they'd been logged as malicious by antivirus firm Avast. "These apps are not necessarily malware, or viruses," explained APC's sister site *TechRadar Pro*. "They might not try to steal data, damage, or destroy the endpoint they're infecting. But they do try to incur extra costs for the victims (either via hidden fees, premium subscriptions, or other similar mechanisms), and are relatively hard to eliminate from the devices."

KEEP YOUR MOBILE DEVICES SAFE
Only download apps from official stores where possible
Don't sideload apps unless through certified channels
Don't trust apps from unrecognised sources

Your website

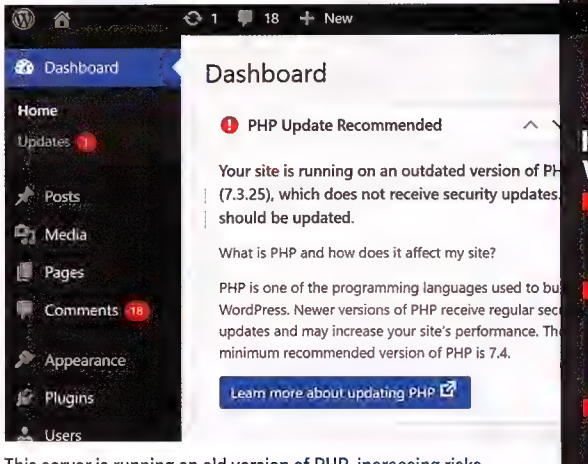
If you have a website, it's probably hosted remotely, but that doesn't mean you can afford to neglect its security. If your site is hacked via an unpatched exploit, it could be wiped – or encrypted by ransomware, leaving you with no good options if you don't have an up-to-date backup.

To a certain degree, the security of your site and your online data is in the hands of your hosting provider. If they're slow to update key web technologies, you'll become more and more vulnerable as time goes on. Those technologies might include software and frameworks such as PHP, WordPress, Joomla and Drupal, plus any plugins you're using. Check that your site is using the latest versions – and if it's not up to date, either patch the software yourself or demand that your provider updates it on your behalf.

Realise, too, that it's not just your own data you need to worry about: you also have a responsibility to your website visitors to keep your site secure. A hacked server could be used as a launch point for attacks on other servers or services, and if you're storing sensitive data on your server – or in a linked database – this could leak, exposing you to potential legal action. One of the most common ways that this happens is via a SQL injection attack, where a malicious actor enters deliberately crafted code into an input box, which is interpreted by the underlying database as a query or instruction, rather than data. It's your responsibility to make sure any input fields on your site aren't susceptible to this type of exploit.

Another popular type of attack is cross-site scripting (XSS for short), in which hackers embed malicious content on your pages, which is then executed in the visitor's browser. It may be possible to defend against XSS content using JavaScript, or by disabling scripts altogether where this is practical.

If you're looking to tighten up your



This server is running an old version of PHP, increasing risks.

WWW
KEEP YOUR WEBSITE SAFE
Keep all software, databases and plugins up to date
Guard against SQL injection, cross-site scripting and other vulnerabilities
Consider installing additional security software

website security, a good start is to install an SSL certificate, which you can do for free via Let's Encrypt (letsencrypt.org). This won't protect against the types of attack above, but it does provide encryption between your site and the visitor's computer, making it harder for snoopers to steal sensitive information.

If you're running WordPress, we'd also recommend using a tool such as Wordfence (**wordfence.com**). This guards against unauthorised logins with IP banning, rate limiting and easy 2FA – and, more than this, it checks your site against other exploits seen on the Wordfence network and monitors files on your server for unauthorised or unexpected changes. It's easy to install from the WordPress repository, and the free tier will go a long way towards hardening an entry-level or personal site. For the full feature set you can sign up for the $119 per year Premium plan, which includes real-time firewall rules, malware signature scanning and a dynamically updated IP blocklist.

Your smart devices

Smart home devices from big-name manufacturers shouldn't normally be a major security concern – but don't be complacent. Doorbell manufacturer Ring found itself the subject of a class action lawsuit after hackers took over users' devices. According to *The Guardian*, one Ring user claimed that, while he was watching TV one night, his camera asked "What are you watching?" Another alleges that his children were addressed by an unknown hacker through the device, who commented on their basketball play and encouraged them to approach the camera.

As for doorbells from rival Nest, Which? found that "hackers were able to exploit a Denial of Service (DoS) attack, which effectively is a way to spam the device with requests so that it goes offline. An attacker could use this to stop your doorbell from recording if they want to approach your home".

It goes without saying that, to minimise the chances of exploits such as these, you should ensure your smart devices are running the most recent firmware available. Frequently, they'll update themselves automatically, but it's often possible to perform a manual check through any associated smartphone apps. Once a smart appliance is no longer supported by the manufacturer, consider replacing it.

Aside from firmware updates, settings and options on IoT and smart home devices are normally fairly minimal, so if you want to improve their security you'll need to do it at the network level. You should of course change the default passwords on any smart devices you're using, and ensure the wireless network has strong encryption – ideally the latest WPA3 standard. If your ISP router doesn't support this, you can pick up a cheap WPA3-compliant router for under $200, which you can connect to your existing router to broadcast a secure wireless network – just be sure to turn off Wi-Fi on your old router.

For maximum safety, it's a good idea to connect your IoT devices to a guest network, rather than the main one that handles your computers and phones. This ensures that even if a smart appliance is completely compromised, it's isolated from any devices that might contain personal information or exploitable software. ■

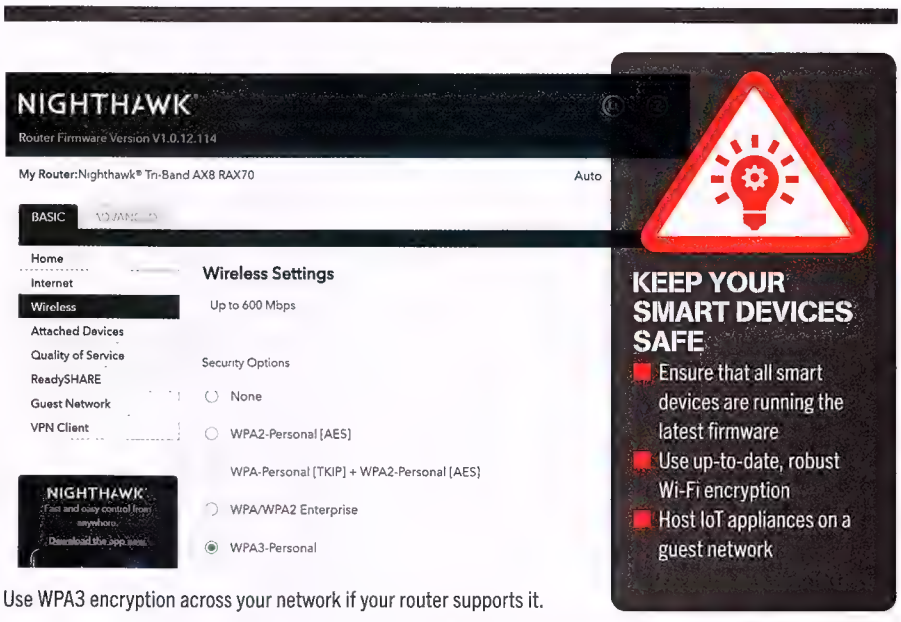
CLOUD SERVICES

When it comes to online services such as Gmail or OneDrive, privacy and security are generally handled entirely by the provider: you'll get little or no visibility or control over the technical or architectural side of things. This is because the resources that power your cloud account are almost certainly shared with thousands or millions of other users; it's simply not practical for the vendor to leave security up to individual users.

If you're buying into a software-as-a-service product, therefore, it's critically important to do your due diligence, especially for businesses (see p62). Check for compliance with the ISO 27000 family of standards for information security management, and in particular ISO 27017 and ISO 27018. The former is a code of practice that aims to reduce the risk of security problems in cloud environments; ISO 27018 is concerned with privacy and minimising risk when handling personally identifiable information in cloud environments.

Although it's not exactly a security concern, you should also consider how you're going to get your existing data into a cloud service – and how you might get it out again at the end of a long-term contract. Moving accounts or databases between online services may be difficult or even impossible: your best option might be to start from scratch at the start of the next financial year, after exporting historic records as PDFs, spreadsheets or an alternative interchange format. Consider, too, how you'd continue to function if the service suffered an outage, or even unexpectedly went out of business: keeping local copies of your data can reduce your exposure.

For businesses that have multiple users accessing SaaS platforms, accounts must be regularly audited, to ensure no-one can access anything they shouldn't be able to; where possible you should also check login times, locations and activities. One of the most common ways that businesses are exploited is via employees abusing their access, or being tricked into giving away passwords or other sensitive information. Implement 2FA where possible, mandate the use of strong, complex passwords on all accounts – and it goes without saying that access must be promptly revoked when someone leaves the organisation.



Use WPA3 encryption across your network if your router supports it.

HOW TO PROTECT YOUR BUSINESS IN 2024

DAVEY WINDER REVEALS THE BIGGEST THREATS THAT HIT BUSINESSES IN 2023 AND WHAT'S LIKELY TO HAPPEN NEXT YEAR.

On p58 we look at the ways in which home networks and personal devices are most likely to be attacked in 2024. But what about businesses? You might assume that cybercriminals would focus their attentions on the biggest organisations – after all, those are the ones best able to afford huge ransoms. In fact, smaller companies can and do get attacked all the time.

"Regardless of the size of the business," said Matt Cooke, strategist at cybersecurity specialist Proofpoint, "if they have a bank account, or sensitive information to steal, they are very much at risk." Proofpoint's researchers have found that 72% of organisations with fewer than 500 employees have dealt with a material loss of sensitive information within the past 12 months.

Indeed, small and medium-sized businesses are prime targets for malicious actors. Recent research from cybersecurity specialist Trellix (**trellix.com**) reveals that companies with between 51 and 200 employees are the most common victims of ransomware campaigns, representing a third of all attacks in Q1 2023.

"Smaller, less prominent organisations often lack the resources to implement robust security measures, either from a financial or skill-based standpoint," explained Trellix VP Fabien Rech.

To protect your company and data, therefore, it's vital to be aware of the threats you're likely to encounter, and to direct your (likely limited) resources accordingly, so as to minimise exposure to these security risks.

Phishing

One important thing to understand is that your small business will mostly face the same range of threats as larger ones. This is because, by and large, cybercriminals are creatures of habit. They will use tried and trusted methods to attack your networks and data, sometimes with an indiscriminate "spray and pray" approach, other times with carefully targeted attacks. In both cases, by far the most common threat facing businesses of all sizes is phishing.

The challenge with phishing is that it comes in many forms. Michael Skelton – a long-time APC reader and current VP of security operations at Bugcrowd – notes that, while most associated with email, phishing can equally take place via SMS, online chat services or even live telephone calls. The common theme is using social engineering to trick employees into revealing sensitive information, especially login credentials, which can then be used for further mischief. "Once armed with this information," Skelton explained, "cybercriminals can bypass security measures and gain access to systems where they can initiate attacks like ransomware or data breaches."

RANSOMWARE ATTACK
Your personal files are encrypted
You have 5 days to submit the payment!!!
To retrieve the Private key you need to pay
Small businesses are a major target for ransomware attacks.

There is some positive news: while phishing is a widespread threat, most campaigns are far from sophisticated. Many attempted attacks can be defeated simply by recognising the red flags, such as unexpected invitations to open an untrusted attachment or log into an unfamiliar untrusted website.

"Staff cyber-awareness training is particularly important in combatting phishing," said Jamie Akhtar, CEO and co-founder at CyberSmart. "It doesn't have to cost a lot or take hours of employees' time; a basic grounding should help them spot most threats."

Sometimes, however, cybercriminals will target specific employees of a business – an attack type sometimes known as "spear phishing" or "whaling". Such tailor-made attacks can be much harder to spot, and the goal might not be merely to steal information, but to trick trusted staff into literally giving away large sums of money. "Attackers impersonate executives within businesses, urging employees to quickly transfer funds from one account to another," warned David Emm, principal security researcher at Kaspersky.

"These emails are often expertly crafted, and due to the urgency conveyed by the scammers, targets frequently fail to question their authenticity and hand over information or transfer the funds as requested." The risk can be mitigated by implementing strict processes to cover financial transfers, such as requiring sign-off from more than one named individual in the business, and getting direct confirmation though a trusted communications channel, such as a face-to-face meeting or an internal telephone extension.

Ransomware

When ransomware hits the news, it's normally because high-profile

Enabling 2FA might sound obvious, but it can have a huge impact for SMBs.

organisations have been hit with demands for enormous sums of cash. However, a report by Management Today found that more than 60% of global ransomware attacks between January 2020 and July 2022 were on small businesses.

"Small businesses are especially at risk to ransomware attacks," noted Lewis West, head of cybersecurity at tech recruiter Hamilton Barnes. "Cybercriminals know that smaller businesses are much more likely to pay the ransom, as they are not as equipped to absorb the attack as larger businesses might be."

"Where purse strings are tight, time offline is money lost," agreed Azeem Aleem, a director of Sygnia (**sygnia.co**). "Many small businesses opt to pay the ransom quickly in a knee-jerk reaction – unaware that the threat attacker may then choose to go in for a second attack, or only release some of their data."

If you do get hit, rather than paying up right away, consider engaging a security expert trained in ransomware negotiation. "These experts investigate how the threat actor gained access, often straight from the horse's mouth," Aleem said. "They use various data-extraction and negotiation techniques, similar to a real-world hostage scenario. This can buy more time to contain the threat, help the business negotiate a lower ransom and help with remediation."

However, even if you do reach an agreement with the attacker, there's no guarantee that your data won't still be sold online after you've made the payment – nor indeed any real assurance that working decryption keys will actually be provided. It's far better to mitigate the ransomware risk as far as possible in the first place.

"There are a couple of things SMBs can do to protect themselves," Jamie Akhtar said. "First of all, invest in upskilling staff. Most ransomware attacks start with human error, and training will make this less likely. Second, ensure that you're using data backups for anything important – and have a plan for what to do if the worst does happen."

Supply-chain attacks

While you may be doing all you can to protect your own business from online attacks, you have far less control over the defences of your suppliers. Supply-chain attacks are growing in frequency and seriousness: indeed, what has been referred to as the biggest data theft of the year was achieved using a supply-chain attack. During the first half of 2023, the Clop ransomware group exploited a zero-day vulnerability in the MOVEit file transfer tool, used by organisations of all sizes from small businesses to government agencies, to steal data on a huge scale. It's been reported that more than 2,000 organisations were caught up in the ongoing security breaches, and more than 62 million people were impacted by data thefts.

"Cybercrooks have learned that finding and exploiting a vulnerability in a widely used software solution will give them an exponential push," observed Dirk Schrader, CISO and VP of security research with Netwrix (**netwrix.com**). "One single vulnerability will give them an inroad into many IT estates."

There may be limits to how far you can audit and secure your tools, but being aware of the risk can help you reduce your exposure. "First of all, ensure your own cybersecurity is in order," Akhtar recommended. "Second, write cybersecurity requirements into RFPs and contracts with smaller suppliers."

Fileless attacks

Fileless attacks are a type of exploit that commonly involve an adversary hijacking the existing software on a device for malicious purposes. Such attacks are called fileless because they take place in memory; for example, a fileless attack might be launched via a Windows or PowerShell script, running inside a genuine trusted application, or even on a cloud server. Often, no trace of the malicious software is written to the hard disk, either on your desktop or in the data centre.

"This lack of footprint or signature makes it hard for most antivirus software to detect a threat, and hackers are well aware of this," said Robert Smith, cybersecurity product manager at cloud services provider M247 (**m247.com**).

> ""Economic uncertainty has made investment in cybersecurity tricky for many small businesses," Akhtar said, "but it's not an optional cost, and it doesn't have to be expensive.

Three threats to take seriously in 2024

5G NETWORKS AND IOT DEVICES

"As smart tech and 5G networks expand, hackers will have more opportunities to target vulnerable IoT devices. Small businesses can counter this threat by installing firewalls, using VPNs to encrypt traffic and regularly updating router firmware. You should also segment your network to remove single-point-of-failure vulnerabilities, and ensure all IoT devices are running the latest versions of operating systems and security tools."

Jamie Akhtar, CyberSmart

ADVANCED PERSISTENT THREATS

"Our researchers have found that threat actors appear to be scaling existing tactics seen in enterprise-targeted phishing campaigns for less robust SMB environments. These include the use of compromised infrastructure in phishing campaigns; regional targeting by state-aligned actors for financial theft; and managed-services providers being targeted via phishing, introducing the threat of supply-chain attacks."

Matt Cooke, Proofpoint

AI-POWERED ATTACKS

"The next evolutionary step in phishing attacks is likely to be AI-powered campaigns making full use of large language models. You can expect fraudulent communications to become more sophisticated, and more targeted at scale. You can mitigate this with regular awareness training, multi-factor authentication, and ensuring employees use direct sources for logging into corporate services."

Michael Skelton, Bugcrowd

"This is why 70% of the malware attacks we see today are fileless and operating in the cloud."

How can you best mitigate against Fileless attacks? "Endpoint Threat Detection and Response (EDR) can provide much-needed protection to businesses," Smith said. "EDR uses behavioural analysis to monitor your data and what tasks you normally carry out on your device, and can thereby detect when there are changes to your daily activities caused by malware." Advanced EDR protection can help small businesses block attacks that would otherwise be almost impossible to detect.

Cryptocurrency fraud

"The popularity of cryptocurrencies and their typically high transaction volumes have made cryptocurrency exchanges very attractive for small businesses," said Sygnia's Azeem Aleem. This is because they allow companies to transfer sums of money of any size very quickly, with minimal or no fees.

"Unfortunately," Aleem continued, "companies handling crypto may be targeted by tailored attacks, performed through quick, anonymous transactions, which are not easily detected until it's too late." To mitigate the attack threat, Aleem said, small businesses need to understand how these crypto attacks unfold.

Kaspersky has put together a useful resource illustrating some of the different cryptocurrency attacks (see **tinyurl.com/APC528kas**) that have taken place over the past year. These include the use of Trojanised hardware wallets, server hacks, fake Chrome extensions and clipboard-injected malware.

Overall, Kaspersky advises organisations to "treat all crypto-related offers, emails, letters and innocent questions with maximum suspicion, and always use security software tailored for crypto investments on all relevant devices".

Underinvestment in cybersecurity

The final threat category is, perhaps, the hardest to overcome – especially in times of high inflation, while businesses are facing bottom-line challenges at every turn. Simply put, the issue is a shortage of investment in cybersecurity. CyberSmart's Jamie Akhtar shares an alarming statistic: fully one- third of the small businesses surveyed for an upcoming report had either decreased their cybersecurity investment since the cost of living crisis, or admitted that they had never really invested in it at all.

"Economic uncertainty has made investment in cybersecurity tricky for many small businesses," Akhtar said, "but it's not an optional cost, and it doesn't have to be expensive. Many SMBs could benefit from consolidating and refining their security estate to focus on the must-haves."

And so we come back to the question: how should a small business best allocate its resources to mitigate cyberthreats? Believe it or not, the answer might not involve any new technology spending at all. Part of the solution is simply to prioritise stopping threats before they reach their intended victims. "Start with a proactive, not reactive mindset," suggested Michael Skelton. "Assume that the question is when, not if, an employee's account is going to be compromised. Then, explore the security features of your cloud-based offerings, ensuring that two-factor authentication, appropriate lockout policies and any other relevant mitigations are enabled for your organisation."

To support your defensive efforts, experts recommend a human-first approach to cybersecurity. "Today's attacks target people, not just technology," points out Proofpoint's Matt Cooke. "Cybercriminals have found new ways to exploit the instincts of curiosity and trust that lead well-intentioned people to play into the hands of the attacker."

"Culture eats technology for breakfast," agreed Rupert Lee-Browne, founder and chief executive of payments fintech Caxton (**caxton.io**). "Fundamentally, our vulnerability at the hands of the scammers is a cultural issue. We need to build a strong culture within the business of understanding where the risks are, in order to beat the criminals."

How can that be achieved? Over to Lewis West, head of cybersecurity at Hamilton Barnes. "Training employees to recognise attackers' methods is an effective way to reduce the number of successful cyber-attacks, especially phishing attacks," said West. "Companies should be embarking on in-house training for their teams, to improve their online safety knowledge and flag the types of scenarios to which staff could fall victim: phishing, malware, ransomware, denial of service attacks and more."

Ben Aung, chief risk officer at Sage, sums up the message in three bullet points:

- **"Make cybersecurity visible and part of your business goals – this includes being clear on how it relates to them, and ensuring cybersecurity is being talked about and promoted by leaders.**
- **"Focus on the basics – setting long and strong passwords, enabling two-factor authentication and reporting suspicious emails might sound like obvious activities, but they can have a huge impact for smaller businesses.**
- **"Implement an easy and quick way for people to report cybersecurity issues – a clear, consistent process reduces confusion and ensures that everyone feels safe to raise concerns and act on them. There is no such thing as over-reporting in cybersecurity."**

Even though your SMB probably doesn't have the same security resources as large enterprises, you can fend off the majority of attacks by taking an intelligent approach to cybersecurity that focuses on the most common threats, and the most exploited vulnerabilities. ■

Never pay for PC repairs

You don't need to be a technical expert to solve many common Windows problems. Robert Irvine explains how you can easily fix your PC for free using the repair tool FixWin.

WHAT YOU CAN DO

- Fix corrupt system files that make your PC crash
- Restore and repair missing and broken features
- Mend a broken internet or Wi-Fi connection
- Force Windows to recognise installed devices, such as your CD drive
- Stop Windows Update hanging when updating
- Solve problems relating to your antivirus software
- Perform complex registry tweaks with one click

When something goes wrong with your PC, it's natural to panic and start frantically scouring the web for advice. But the information you find online is often unhelpful and confusing, which might lead you to consider paying for professional technical support.

Thankfully, it's possible to fix most Windows problems for free, using tools built into the operating system. But unless you have an encyclopaedic knowledge of the Windows registry and Command Prompt, that's often easier said than done, which is where FixWin (**tinyurl.com/APC528fixwin**) proves invaluable.

This brilliant free PC-repair program provides dozens of solutions to common computer woes. Created by the webmaster of PC-help site The Windows Club (**www.thewindowsclub.com**), it performs complex commands and tweaks with one click and lets you run Windows' own troubleshooters – which Microsoft plans to remove soon (see **tinyurl.com/APC528ts**).

In this feature, we explain how to use FixWin to repair a wide range of PC problems, without paying a cent. The latest version (FixWin 11.1) works with both Windows 10 and 11, and doesn't require installation – just click the Download File button at **tinyurl.com/APC528fixwin**, then extract and run the contents of the ZIP file.

Note that because it makes changes to your PC, FixWin may trigger a SmartScreen warning, but it's completely safe to use so click 'More info' then 'Run anyway'.

© Getty

What to fix first with FixWin

1 Fix damaged system files that cause crashes

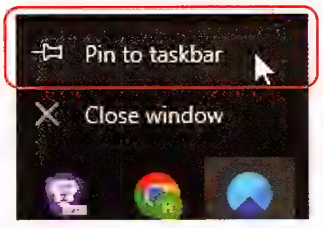
Before you try any other repairs in FixWin, you should run the System File Checker Utility on the Welcome screen (1 in our screenshot below). This scans your PC to check whether protected system files have been altered, and fixes any that are damaged or missing by replacing them with correct versions. It's particularly useful if you're experiencing frequent crashes, including the dreaded Blue Screen of Death, or seeing error messages about missing DLL files.

Running the System File Checker (SFC) usually involves opening Command Prompt in Windows, as an administrator, and typing the command **sfc /scannow. FixWin** makes things easier by doing the same thing with the click of a button, without you needing to type anything.

SFC takes a few minutes to complete its scan, and will respond with one of three results: that it didn't detect any 'integrity violations', that it found and successfully repaired corrupt files, or that it "found corrupt files but was unable to fix some of them". Don't worry if you get the last result, because FixWin provides a possible solution through its DISM option.

DISM (Deployment Image Servicing and Management) detects and fixes corrupt files in the Windows system image to allow SFC to work properly. Rather than type **Dism /Online / Cleanup-Image /RestoreHealth into Command Prompt**, FixWin lets you run the DISM command by clicking the Repair Windows System Image button 2 on its Welcome screen. Once the scan and repairs are complete, click System File Checker Utility again to replace your corrupt or missing system files.

PIN FIXWIN TO YOUR WINDOWS TASKBAR



Because FixWin is a tiny portable tool that doesn't require installation, it doesn't add a shortcut to your Start menu or desktop. This prevents clutter but also means you need to run the program's EXE file every time you want to use it to repair a problem. It doesn't even offer options to create a shortcut or run it automatically on startup.

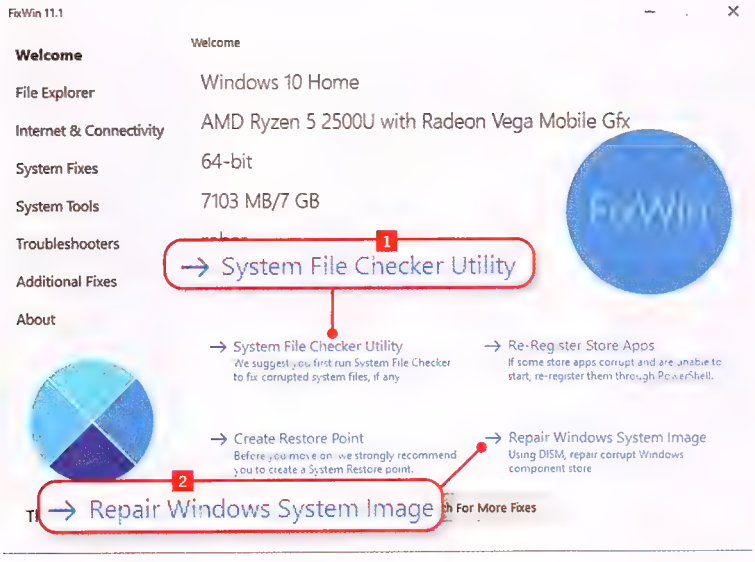
To save time, right-click FixWin's taskbar icon while you have it open and select 'Pin to taskbar' (see screenshot). This will give you a one-click shortcut to launch the program when you need to perform a fix.

2 Solve problems with Microsoft Store apps

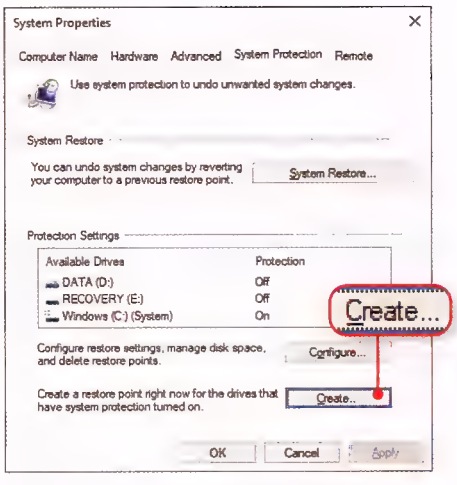
Lots of great free Windows tools are now available as apps from the Microsoft Store, rather than – or as well as – traditional desktop programs. These apps are intended to be easier, faster and safer to use, but they sometimes suffer corruption problems that prevent them from opening or cause them to freeze or crash.

To repair misbehaving Microsoft Store apps, click the Re-Register Store Apps button on FixWin's Welcome screen. This will launch Windows PowerShell with administrator privileges and re-register all the apps that came installed with Windows and any that you've downloaded yourself.

Don't worry if you see red text warning that 'deployment failed' because resources are in use – this merely means a particular app is already running and presumably, therefore, doesn't need fixing.


FixWin 11.1
Welcome
File Explorer
Internet & Connectivity
System Fixes
System Tools
Troubleshooters
Additional Fixes
About
Windows 10 Home
AMD Ryzen 5 2500U with Radeon Vega Mobile Gfx
64-bit
7103 MB/7 GB
1
System File Checker Utility
System File Checker Utility
We suggest you first run System File Checker to fix corrupted system files, if any
Re-Register Store Apps
If some store apps corrupt and are unable to start, re-register them through PowerShell.
Create Restore Point
Before you move on, we strongly recommend you to create a System Restore point.
Repair Windows System Image
Using DISM, repair corrupt Windows component store
2
Repair Windows System Image
For More Fixes

Use FixWin's SFC and DISM tools to detect and fix corrupt Windows system files.



Create a system restore point using FixWin before you make changes to your PC.

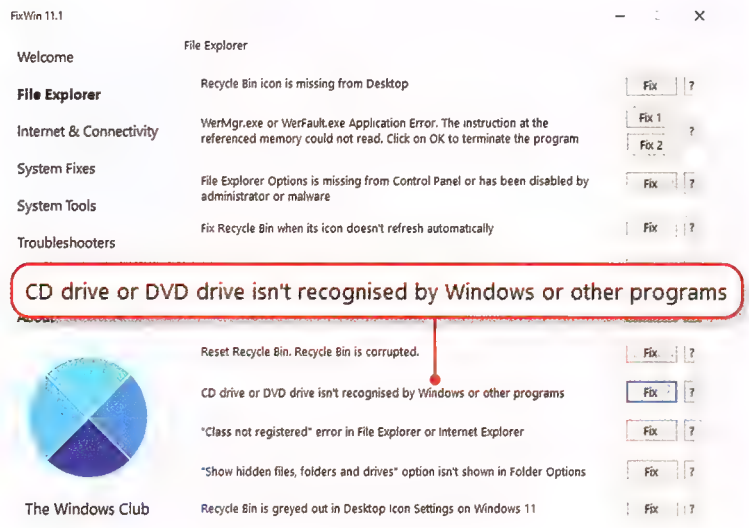
3 Undo changes that mess up your PC

Before you make significant changes to your PC, it's essential to create a system restore point, so you can roll back your system if anything goes wrong. Windows no longer creates points automatically and Microsoft has hidden this important feature in Windows 10 and 11 – you either need to type system restore in the search box and click 'Create a restore point', or open the Run box and type **sysdm.cpl** – so FixWin places the option upfront.

Click the Create a Restore Point button on the Welcome screen to open the System Properties box on the System Protection tab. Ensure that protection is enabled for your main hard drive, then click the Create button (see screenshot above), enter a name for the restore point (the date and time are added automatically) and click Create.

Should you need to roll back your system, click 'Create a Restore Point' on the Welcome screen again and choose System Restore to start the restoration process.

Fix problems with File Explorer


FixWin 11.1
Welcome
File Explorer
Internet & Connectivity
System Fixes
System Tools
Troubleshooters
File Explorer
Recycle Bin icon is missing from Desktop
WerMgr.exe or WerFault.exe Application Error. The instruction at the referenced memory could not read. Click on OK to terminate the program
File Explorer Options is missing from Control Panel or has been disabled by administrator or malware
Fix Recycle Bin when its icon doesn't refresh automatically
CD drive or DVD drive isn't recognised by Windows or other programs
Reset Recycle Bin. Recycle Bin is corrupted.
CD drive or DVD drive isn't recognised by Windows or other programs
"Class not registered" error in File Explorer or Internet Explorer
"Show hidden files, folders and drives" option isn't shown in Folder Options
Recycle Bin is greyed out in Desktop Icon Settings on Windows 11
Fix
The Windows Club

Force Windows and third-party tools to recognise your CD/DVD drive.

4 Fix an undetectable CD/DVD drive

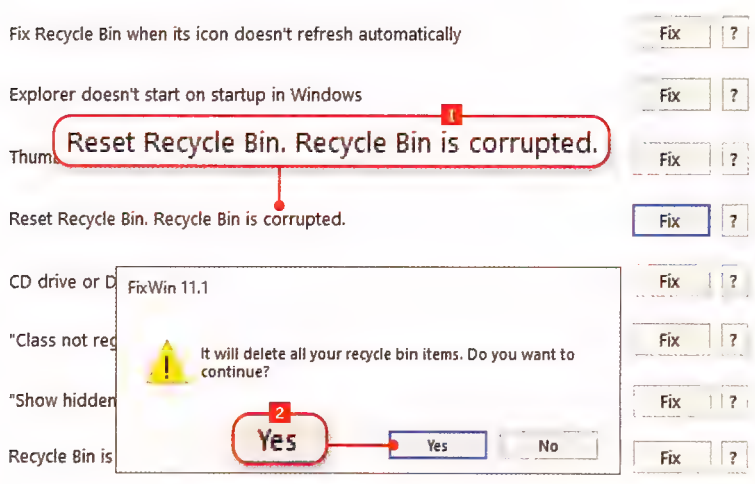
When you insert a disc in your CD/DVD drive to copy content to or from it, Windows – or the third-party burning/ripping software you're using – should detect it automatically. But you may find the drive isn't recognised, especially if you haven't touched it for a while, and wonder whether you need to replace or repair the undetectable hardware.

FixWin provides a simple solution to this problem to save you splashing out on a new or serviced disc drive. Select the File Explorer tab in the left-hand menu and find the entry CD drive or DVD drive isn't recognised by Windows or other programs (see screenshot right). Click the Fix button and FixWin will delete two values from a registry key that relates to the disc drive, and reboot your PC. Hopefully, Windows – or the dedicated software – will now recognise your drive and the CD or DVD it contains.

5 Repair a corrupted Recycle Bin

It's easy to take the Windows Recycle Bin for granted until it stops working properly, and you're unable to delete files – or access items you've previously deleted.

FixWin's File Explorer tab provides several one-click solutions to common Recycle Bin problems. The most powerful is Reset Recycle Bin. Recycle Bin is corrupted (1 in our screenshot below), which fixes "all Recycle Bin problems". It works by running a command in Command Prompt that resets the Recycle Bin for all your hard drives. The downside is that you'll lose everything currently stored in the bin – click Yes 2 if you're happy to go ahead.



Fix a corrupted recycle bin by resetting it and deleting its contents.

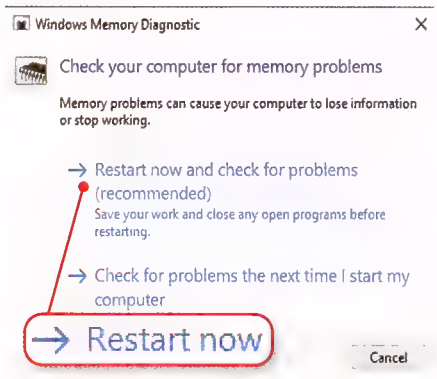
If you want to recover deleted files from the bin, a less extreme fix may suffice. Recycle Bin is missing from desktop restores the bin icon if it's been removed by a program or malware; while Recycle Bin is greyed out in Desktop Icon Settings unlocks the ability to show or hide the bin.

6 Restore missing desktop features

When you boot your PC and are greeted with a blank screen that has no Start menu, taskbar or desktop icons, it's natural to fear it may be broken or infected with malware. But the usual cause is that File Explorer has failed to start alongside Windows, which means none of the standard desktop items can be displayed

FixWin provides a solution to this problem through its setting Explorer doesn't start on startup in Windows. Click the Fix button to tweak the registry value that sets File Explorer to start automatically when Windows does.

To open File Explorer manually, so you can access FixWin to perform the fix, press Windows key+R, type Explorer.exe in the Run box and press Enter.


Windows Memory Diagnostic
Check your computer for memory problems
Memory problems can cause your computer to lose information or stop working.
Restart now and check for problems (recommended)
Save your work and close any open programs before restarting.
Check for problems the next time I start my computer
Restart now
Cancel

FixWin provides two fixes for error messages about Windows memory.

7 Prevent memory errors in Windows

One of the most common – and baffling – error messages in Window warns you that: "The instruction at the referenced memory could not read. Click on OK to terminate the program". The error typically relates to the system files 'WerFault.exe' and 'WerMgr.exe', which form part of the Windows error-reporting system, and means either or both of these files has become corrupted.

FixWin provides two solutions to the problem via the setting WerFault.exe and WerMgr.exe on its File Explorer tab. Click 'Fix 1' to open the Windows Memory Diagnostic tool, then either choose to restart now to check for and fix memory problems (see screenshot above), or do so when you next start your PC.

Click 'Fix 2' to apply a registry tweak that disables the Windows error-reporting system, so you no longer see such messages. This won't adversely affect the performance of your PC, and running SFC will fix the corrupt file(s).

Fix Internet & connection problems

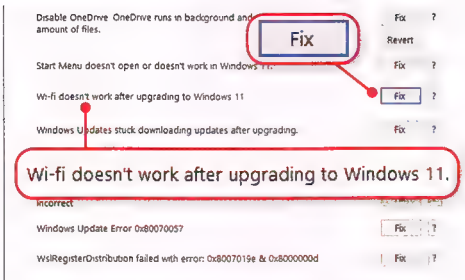
8 Repair a broken internet connection

There are plenty of reasons why you might not be able to get online – both at your end and your internet provider's. FixWin's 'Internet & Connectivity' tab offers several potential solutions for the former, which are worth trying before you contact your ISP's customer service team.

First, click the Fix button next to Cannot connect to internet. There's some problem in Internet Protocol (1 in our screenshot below). This resets your network adapter's TCP/IP settings by running the command netsh int ip reset in Command Prompt. It's often enough to fix your connection, and won't make things worse if the internet protocol isn't the cause.

If that doesn't help, try the option Difficulty connecting internet? Repair Winsock (Reset Catalog) 2. This resets the file 'winsock.dll', which controls how your PC and Windows programs connect to the internet and can knock you offline if it becomes corrupted. FixWin will run a command to replace the damaged file with a new copy of Winsock and restore its default settings.

Finally, if you can connect to the internet but can't load any websites in your browser, your DNS settings may be misconfigured. FixWin's Problem regarding DNS cache resolution 3 uses three commands to clear – or 'flush' – your DNS cache, so you'll (hopefully) be able to access sites again.



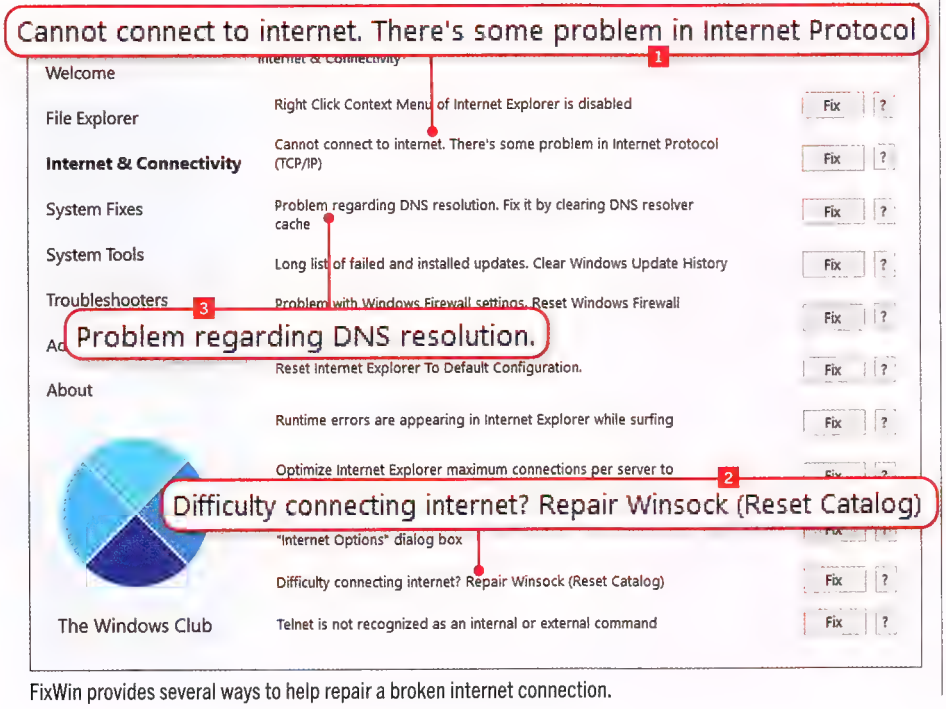
Restore a lost Wi-Fi connection after upgrading to Windows 11.

9 Get your Wi-Fi working again

Some PC users have experienced a problem with their Wi-Fi after upgrading from Windows 10 to Windows 11. When you click the Wi-Fi symbol in your system tray, you may find that no wireless networks are available, so you have to use your Ethernet connection to get online.

FixWin says this is because the upgrade may "mess with some Wi-Fi related drivers and system files", a problem that may cause you to regret upgrading and consider paying for technical help. Before you do so, try clicking Fix next to the Wi-fi doesn't work after upgrading to Windows 11 entry (see screenshot above) on the program's System Fixes tab. This runs a couple of commands in Command Prompt to get your Wi-Fi up and running again.

The fix also works in Windows 10, if you've lost your Wi-Fi connection after installing a Windows update.


Cannot connect to internet. There's some problem in Internet Protocol
1
Welcome
File Explorer
Internet & Connectivity
System Fixes
System Tools
Troubleshooters
About
Right Click Context Menu of Internet Explorer is disabled
Cannot connect to internet. There's some problem in Internet Protocol (TCP/IP)
Problem regarding DNS resolution. Fix it by clearing DNS resolver cache
Long list of failed and installed updates. Clear Windows Update History
Problem with Windows Firewall settings. Reset Windows Firewall
3
Problem regarding DNS resolution.
Reset Internet Explorer To Default Configuration.
Runtime errors are appearing in Internet Explorer while surfing
Optimize Internet Explorer maximum connections per server to
2
Difficulty connecting internet? Repair Winsock (Reset Catalog)
"Internet Options" dialog box
Difficulty connecting internet? Repair Winsock (Reset Catalog)
Telnet is not recognized as an internal or external command
Fix
The Windows Club

FixWin provides several ways to help repair a broken internet connection.

STOP THE WINDOWS FIREWALL BLOCKING PROGRAMS

The built-in Windows Firewall protects your PC against hackers and malware by blocking unauthorised internet traffic – both incoming and outgoing. But sometimes it can prevent legitimate software from connecting to the internet, either because you've changed a setting yourself or a malicious program has done so without your knowledge.

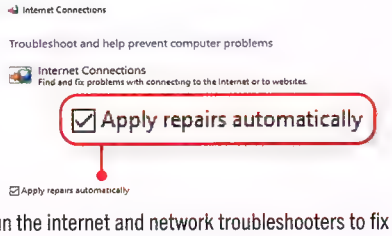
To solve this, click the Fix button next to FixWin's Problem with Windows Firewall settings option. This runs a command that resets the Firewall to its default settings and undoes any changes that are impeding your connection. It's much safer than disabling the firewall, because all unidentified programs will still be blocked, and saves you having to delve into Windows Security to restore the firewall's default settings.

10 Identify and fix network problems

FixWin also gives you one-click access to Microsoft's own troubleshooters for solving internet and network problems. These are otherwise buried in the Windows Settings app, so you might not know to try them when you lose your connection.

Click the Troubleshooters tab in FixWin and select Internet Connections Troubleshooter. When the tool opens, click Advanced, tick 'Apply repairs automatically' (see screenshot below) then click Next. Select 'Troubleshoot my connection to the internet' to identify and fix connection problems.

If no issues are detected, try the Network Adapter Troubleshooter, which finds and fixes any problems with wireless and other network adapters – you can choose a specific adapter or select 'All network adapters'.


Internet Connections
Troubleshoot and help prevent computer problems
Internet Connections
Find and fix problems with connecting to the Internet or to websites
Apply repairs automatically

Run the internet and network troubleshooters to fix connection problems.

Fix problems with Windows Tools

11 Solve Windows Update problems

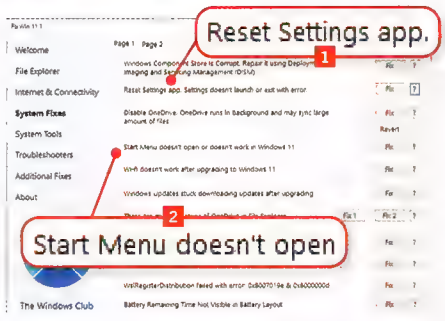
Windows Update is a frequent cause of PC problems, so it's unsurprising that FixWin's System Fixes tab includes repairs for the troublesome feature. One of these, Windows Updates stuck downloading updates after upgrading, relates to an issue many users have experienced after upgrading to Windows 11, but also affects Windows 10.

When you try to install the latest available update, Windows Update gets stuck while 'Preparing to install updates' when updates are 'Pending' or at the 'Checking for updates' stage (see screenshot below). FixWin solves this problem by running two commands in Command Prompt, deleting the Software Distribution folder, then running the commands again. It's definitely worth a try if Windows Update is driving you to despair.

Another useful fix is simply titled Windows Update Error 0x80070057. This is one of the most common Windows Update errors, which has plagued the operating system since Windows XP. It means that Windows has experienced a storage problem, either because there's not enough space to install an update or due to a corrupt file system or registry entries.

FixWin tweaks the registry and resets the Software Distribution folder to let you install Windows updates without getting the error message – though you may need to delete further files manually if lack of space is the issue.

The program's Troubleshooters tab includes a Windows Update Troubleshooter for diagnosing and fixing other update problems using Microsoft's own methods.

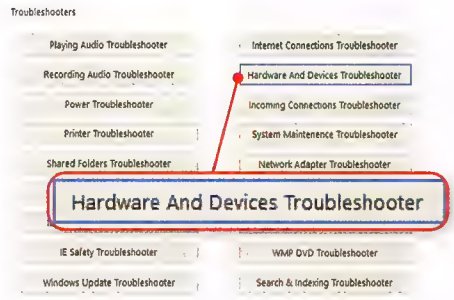


If you can't open Windows Settings or Start menu, FixWin can help.

12 Repair essential Windows features

The Settings app in Windows 10 and 11 gives you access to all manner of important options for controlling how the operating system works and looks. So when you suddenly find you can't open Settings, or it instantly closes with an error message, it's a very big deal indeed.

Thankfully, FixWin provides a one-click solution called Reset Settings app (1 in our screenshot above). This runs a complex PowerShell command that resets the Settings app, so you'll be able to use it again without any problems – you may need to restart your PC.



Run the Hardware And Devices Troubleshooter to update your device drivers.

You can also fix an issue that prevents the controversial Start menu in Windows 11 from opening when you click its taskbar button. Click 'Fix' next to Start Menu doesn't open 2 to run a PowerShell command that solves the problem.

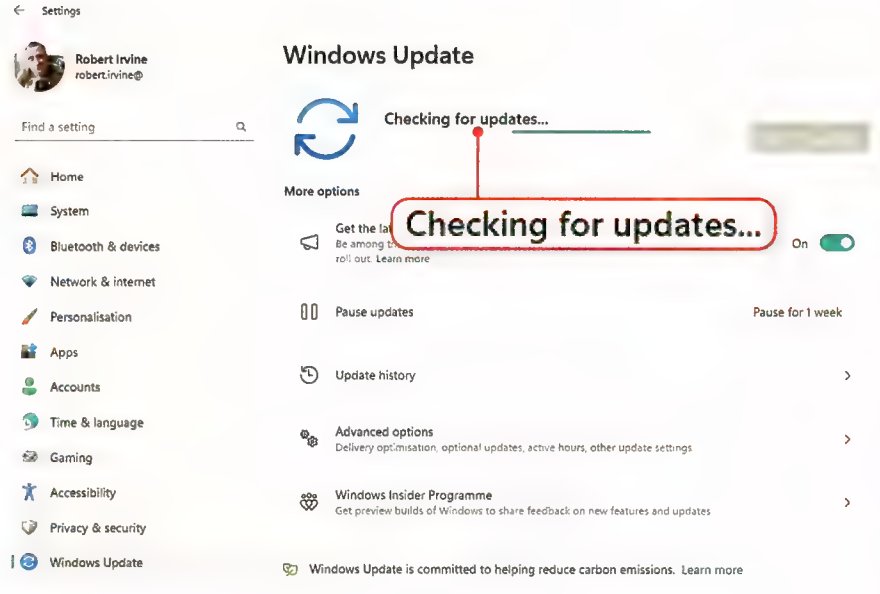
Sadly, FixWin can't restore the Start menu to its traditional appearance – for that you need Open-Shell (**open-shell.github.io/Open-Shell-Menu/**).

If the Window search box on the taskbar isn't working, you can use FixWin to repair it. Select the System Tools tab and apply the Reset Windows Search to defaults fix. This performs a fairly complex set of commands and registry tweaks to restore the search box to its default settings.

Device Manager is another vital Windows component that can cause major headaches when it stops working properly. For example, it may fail to recognise a new device you've connected to your PC, or may be completely empty rather than showing a list of hardware.

These problems occur when the Windows 'Plug and Play' service, which identifies devices and loads the latest available drivers, isn't working. FixWin's setting Device Manager isn't working properly and not showing any devices runs a command and applies a registry tweak to force 'Plug and Play' to start. Reboot your PC and Device Manager will now detect all your connected devices.

You can solve other device problems by running the Hardware And Devices Troubleshooter (see screenshot above) on FixWin's Troubleshooters tab. This checks that all your device drivers are up to date, and installs new ones where necessary – you'll need to restart your PC. There are also troubleshooters for fixing issues with your printer and audio devices.



FixWin offers several solutions for common problems with Windows Update.

Fix Windows Security problems

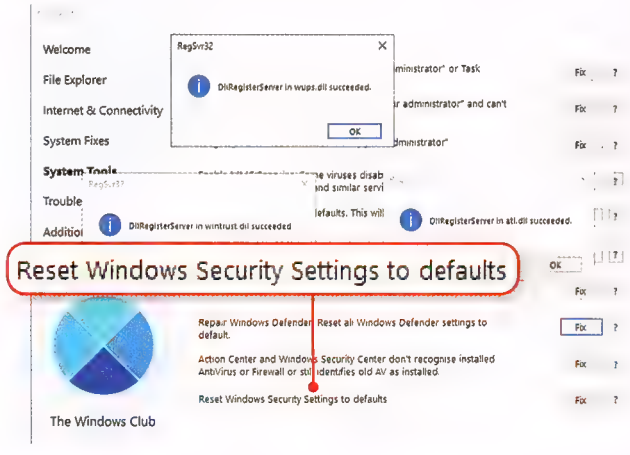
13 Repair your antivirus protection

Microsoft Defender Antivirus, which is built into Windows 10 and 11 as part of the Windows Security app, provides reliable and comprehensive protection against the latest malware threats. However, this powerful antivirus tool isn't infallible, and you may experience problems such as it turning itself off, being disabled by a rogue application or failing to perform a scan.

These issues are usually caused by corrupt files and can be fixed by restoring Microsoft Defender to its default settings.

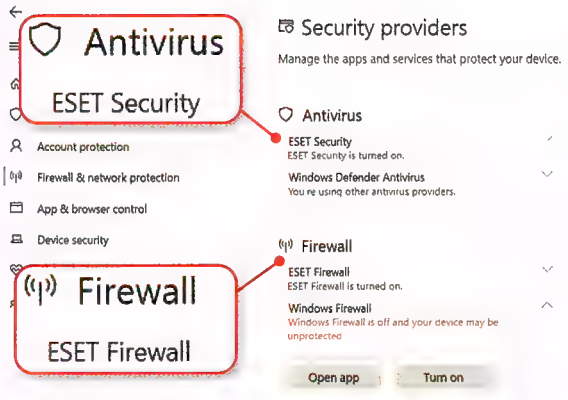
Select the System Tools tab in FixWin and click Fix next to the option Repair Windows Defender. This re-registers nine DLL files and resets related registry keys to address every problem that could be preventing Defender from working properly. You'll see confirmation messages for each DLL file – click OK to close these. Don't worry if any show an error message, because this merely means the DLL file isn't used by your version of Windows.

FixWin also offers the option to Reset Windows Security Settings to defaults (see screenshot below) including



FixWin repairs Microsoft Defender Antivirus by re-registering multiple DLL files.

FixWin can force Windows to detect which security software you have installed.



firewall and network protection, app and browser control, and device protection. This fixes Windows Security if it keeps crashing or not opening, and also allows you to instantly optimise your protection if any important options have been changed.

If you prefer to use third-party antivirus software in Windows, such as Norton 360, Windows should automatically detect its installation and disable Microsoft Defender and Windows Firewall. It should also show your preferred program(s) under 'Security providers' in Windows Security's Settings and in the Action Centre (which you access by pressing Windows key+A or clicking the speech-bubble icon at the end of your taskbar).

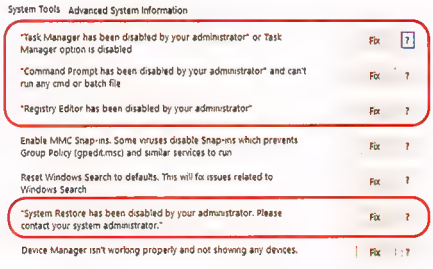
If Windows doesn't recognise your antivirus software, the problem is probably caused by leftover traces of a security tool you've uninstalled. The removed program may still be identified as your security provider (such as the ESET examples in our screenshot above) or Windows Security may warn you that no antivirus software or firewall can be detected.

You can fix the issue using the option Action Center and Windows Security Center don't recognise installed AntiVirus... on FixWin's System Tools tab. This resets the Windows Management Instrumentation service, which is responsible for reporting whether – and which – antivirus software is installed.

14 Unlock Windows tools disabled by malware

Unless you're using a company-owned computer, you should be able to access Windows tools without being told they've been 'disabled by your administrator'. Sometimes this restriction is imposed by a program you've installed, but there's also a risk it's caused by malware. FixWin can unlock certain features that have supposedly been disabled by your administrator, allowing you to use them as normal.

On the System Tools tab, you'll find options for removing the restriction from Task Manager, Command Prompt, the Registry Editor and System Restore (see screenshot below). Just click the Fix button next to each one to delete the registry value that's locking that tool. Make sure you run a full antivirus scan afterwards, in case there is a sinister cause.


System Tools
Advanced System Information
"Task Manager has been disabled by your administrator" or Task Manager option is disabled
"Command Prompt has been disabled by your administrator" and can't run any cmd or batch file
"Registry Editor has been disabled by your administrator"
Enable MMC Snap-ins. Some viruses disable Snap-ins which prevents Group Policy (gpedit.msc) and similar services to run
Reset Windows Search to defaults. This will fix issues related to Windows Search
"System Restore has been disabled by your administrator. Please contact your system administrator."
Device Manager isn't working properly and not showing any devices.
Fix

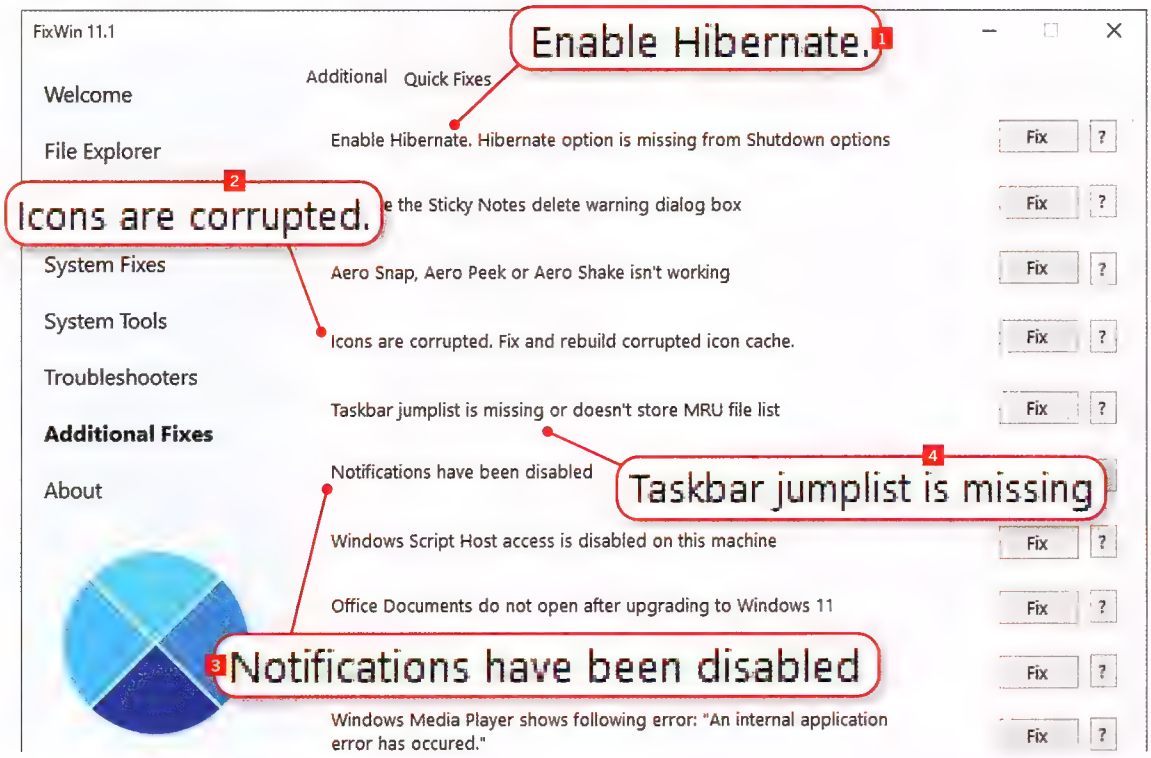
Use FixWin to remove 'administrator' restrictions from Windows tools.

DISCOVER HOW FIXWIN FIXES PROBLEMS

Throughout this feature, we've explained what FixWin does when you click the Fix button for specific settings, but you may want to know how it performs other fixes. To find out, click the question-mark icon next to an option. This will give you a description of the cause of the problem, and tell you the solution FixWin will attempt. In the Manual section (see screenshot), you'll see details of the exact steps the program will take, such as tweaking a certain registry setting or running a specific command in Command Prompt.

To save the fix for future reference or share it with someone, double-click the instructions to copy them to your clipboard. You can then paste the text into a document or email, to try the fix without using FixWin.

Five quick fixes you can make with FixWin


FixWin 11.1
Welcome
File Explorer
System Fixes
System Tools
Troubleshooters
Additional Fixes
About
Additional Quick Fixes
Enable Hibernate.
1
Enable Hibernate. Hibernate option is missing from Shutdown options
Fix
?
2
Icons are corrupted.
e the Sticky Notes delete warning dialog box
Aero Snap, Aero Peek or Aero Shake isn't working
Icons are corrupted. Fix and rebuild corrupted icon cache.
Taskbar jumplist is missing or doesn't store MRU file list
4
Taskbar jumplist is missing
Notifications have been disabled
Windows Script Host access is disabled on this machine
Office Documents do not open after upgrading to Windows 11
3
Notifications have been disabled
Windows Media Player shows following error: "An internal application error has occured."

FixWin's Additional Fixes tab provides a range of useful Windows tweaks.

Re-enable the Hibernate feature

The power-saving feature Hibernate is unnecessary if your PC has an SSD, but it's useful for traditional hard drives.

If the Hibernate option has disappeared from your shutdown menu, you can use the Enable Hibernate setting (1 in our screenshot above) on FixWin's Additional Fixes tab to bring it back.

This runs a command and tweaks the registry to place Hibernate alongside Sleep, 'Shut down' and Restart.

Rebuild corrupted desktop icons

A corrupted desktop shortcut won't affect the performance of your PC as severely as a corrupted system file, but it does look unsightly – with a blank-page icon rather than a program logo or folder. To restore your desktop icons to their intended appearance, select the Icons are corrupted option on the Additional Fixes tab 2. This clears and rebuilds the icon cache to give your shortcuts their intended design.

Restore desktop notifications

Desktop notifications often provide useful information such as warning you your antivirus is turned off or telling you when an update is available. If your notifications have gone silent, apply the Notifications have been disabled fix 3, which deletes the registry value that's blocking them.

Display taskbar 'jump lists'

If your taskbar icons are no longer showing a list of recently opened files and web pages when you right-click them, FixWin can restore these 'jump lists'. On the Additional Fixes tab, click Fix next to Taskbar jumplist is missing... 4 to reset the folders relating to this feature.

Stop OneDrive running in the background

Microsoft recently imposed a storage restriction in OneDrive, and that's not the only reason to stop using the service. In Windows 11, OneDrive runs automatically in the background, consuming data and power as it syncs files between your PC and the 'cloud'.

You can prevent this from happening using the Disable OneDrive setting on FixWin's System Fixes tab. This tweaks the registry to stop OneDrive syncing your files, and also works in Windows 10. FixWin provides a Revert button if you change your mind.

FIVE FIXWIN SETTINGS YOU SHOULD IGNORE

Reset Internet Explorer

FixWin includes several IE fixes that have presumably carried over from a previous version of the program. Microsoft's old browser is officially dead, so there's no point repairing it now.

WslRegisterDistribution failed with error

This baffling tweak is aimed at software developers who use the Windows Subsystem for Linux (WSL). The rest of us needn't worry about it.

Homegroup Troubleshooter

Microsoft has removed the HomeGroup networking feature from Windows 10, and never included it in Windows 11, so clicking this troubleshooter just tells you the service is disabled.

Mail or Calender app(s) are crashing

Not only does this setting misspell 'calendar', but it also directs you to a web page to download a troubleshooter that doesn't exist. It's one of FixWin's few flaws.

Telnet is not recognised

Telnet is an old network protocol for logging into computers remotely. It's no longer commonly used and isn't secure because it doesn't encrypt data, so don't worry about it not working. ■

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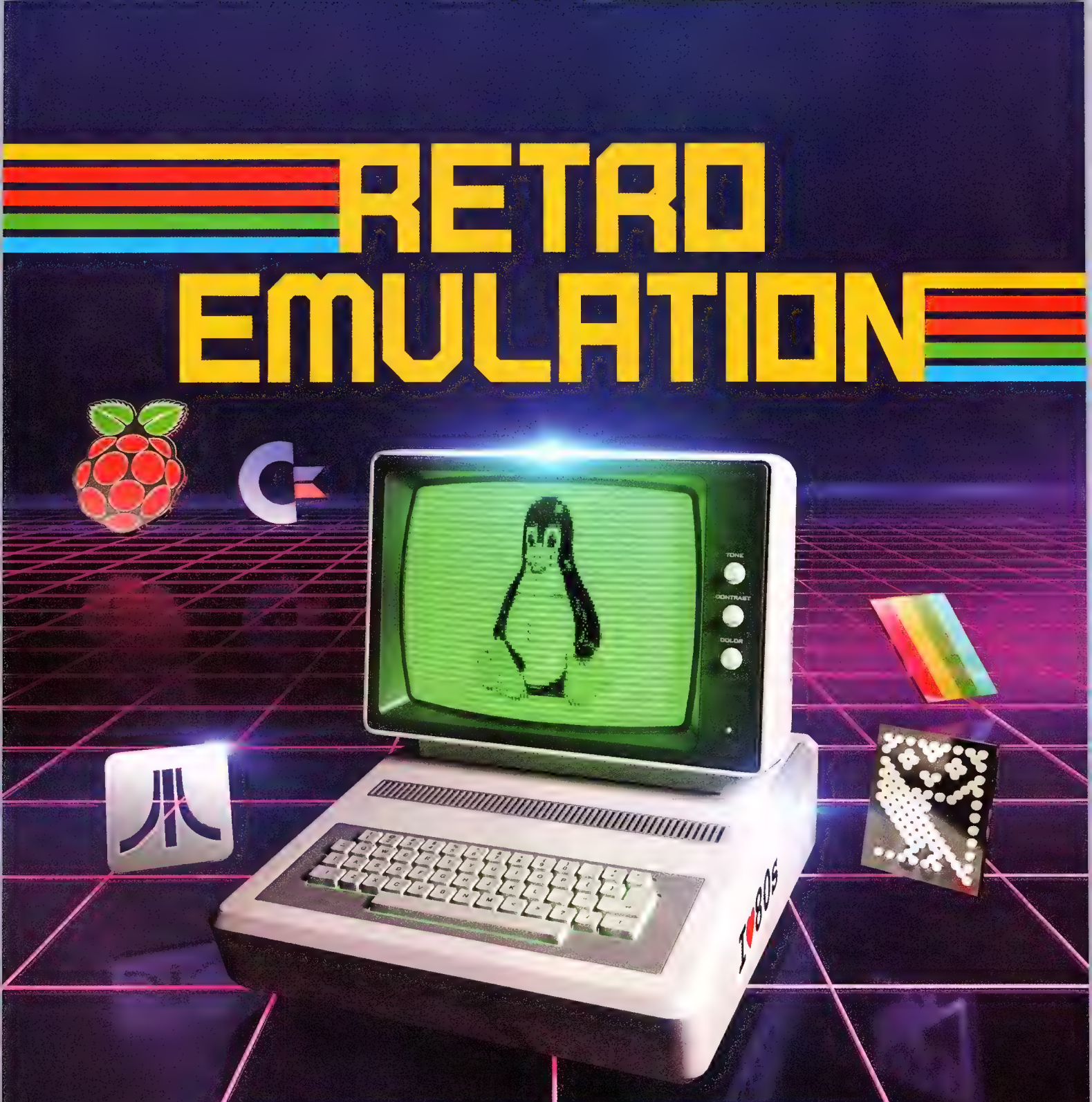
techradar.com

RETRO EMULATION



The *APC* team all have their own favourite retro memories. **Jonni Bidwell** helps you relive yours.

We're sure everyone reading this has at least one fond memory of computing in a past era. Maybe it was playing the classic platform game *Crash Bandicoot* on the original PlayStation, or was it discovering the SAY() and TRANSLATE$() functions in Amiga Basic? Perhaps it was even reverse engineering a printer driver for a PDP-11 microcomputer. Whatever your rose-tinted memories of bygone computing eras, it's fun to indulge them.

There are thousands of open-source emulators and tools to help us on this trip into nostalgic reverie. Retro gaming isn't new – the first version of MAME (Multiple Arcade Machine Emulator) appeared in 1996 and enabled PC users to relive hours in the arcade. MAME is better than ever and can now play over 7,000 titles. For the ultimate experience, we'll show you how to build your own mini arcade cabinet with Pimoroni's Picade.

Emulators abound for the machines that defined home computing, such as the ZX Spectrum, the BBC Micro, and the Commodore 64. Moving on to the 16-bit generation, the Amiga and its rival the Atari ST complete with its ugly mouse.

These machines had some great games, which we'll show you how to play. But they also had great operating systems and applications, so we'll relive some of those histories, too.

RELIVE PAST COMPUTERS

A ROUNDUP OF SOME OF THE RETRO COMPUTERS THAT MADE US SMILE (AND OCCASIONALLY SWEAR).

Retro gaming has long been a popular activity on Raspberry Pi. Soon after its 2012 release, coders worked to get the popular MAME running and other emulators followed suit. The Fuse emulator for the ZX Spectrum series was another early arrival, and Fuse development is alive and well today.

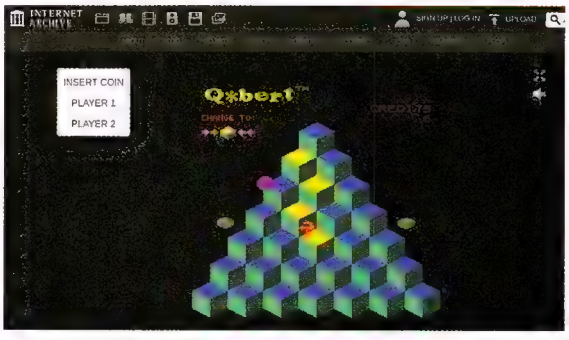
Anyone wanting to recreate the BBC Micro experience, which was particularly popular in the UK in the 1980s, should look at BeebEm (**http://beebem-unix.bbcmicro.com**). It's one of the oldest emulators, having been around since 1994, and will have you reliving your galactic trading days in Elite in no time. You can even run it from a web browser at **https://beeb.webassembly.link**.

C64 on a Pi

One of the best-selling home computers of all time was the Commodore 64, which sold somewhere between 10 and 17 million units between its launch in 1982 and its discontinuation in 1994. Official numbers for the Pi family state that over 45 million units had been sold by March 2022, usurping the C64 and becoming the best-selling computer family in history. And if you want to emulate the C64 on a Pi (or a PC), then look no further than VICE (Versatile Commodore Emulator).

After the C64 came the Amiga. According to Amiberry developer Dimitris Panokostas, Amiga emulation on the Pi began in earnest in 2015, when UAE4ARM was ported to it. Dimitris started work on Amiberry a year later and, today, it's probably the best way to get your Pi to pretend to be an Amiga.

Amiberry uses much of the same emulation code as the venerable WinUAE, and in turn FS-UAE (a Linux port), but with optimizations for lower-powered boards. These all have their roots in the original UAE, which originally stood for 'Unusable Amiga Emulator' because it couldn't do much besides displaying the disk logo. Back then though, most people didn't think Amiga emulation would be remotely possible, so even this was a big step forward.



The Internet Archive's Arcade Collection allows you to play classics such as *Q*bert* in your browser.

If we mention the Amiga, some people will be upset if we don't also mention the Atari ST – you can emulate that on a Pi too. Unlike Amiga emulation, where you can't do a whole lot without copyright-encumbered ROMS, the emulation community at **https://emutos.sourceforge.io** has engineered its own. Combine this with the Hatari emulator and those 520ST memories will come flooding back.

RETRO GAMING ON THE PC

If you're struggling to source a Pi, or don't want to do retro gaming on one, you'll be pleased to hear that all of the emulators and platforms we mention here are available for your PC, too. Emulating newer platforms, such as high-end Amigas and PlayStation, will perform better there too.

If you have an old PC lying around, then you might want to skip the emulation part and run some DOS classics natively. You don't even need a dubiously obtained copy of MS-DOS: the open-source FreeDOS project (**https://freedos.org**) saw a new release in February 2022. That might seem like a while ago, but it's been feature complete for many years and doesn't have the security (or breakage) concerns of modern software. Alternatively, you can run them on modern Linux via DosBox. You'll find a list of open-source games at **https://hellricer.github.io/2020/11/01/opensource-msdos-games.html**.

Many classic games have been reworked for modern platforms. Check out *Widelands* (a port of the classic *The Settlers*), OpenMW (Morrowind), *ET: Legacy* (*Wolfenstein*), *OpenRA* (*Red Alert*, *C&C*, et al), *OpenLara* (*Tomb Raider*), and, of course, *ScummVM* (classic Lucasfilm games including the *Monkey Island* series. These days, it supports a huge number of non-SCUMM games too – see **https://scummvm.org**). The id Software classics *Doom* and *Quake* (and sequels) were open-sourced a while ago, but more eye-candy is available through ports such as *Doomsday Engine*, *PrBoom+*-*RT*, and *RTXQuake* (the last two with glorious ray tracing). If you're a fan of the 1980s, look out for *Thatcher's Techbase*, a *Doom 2* add-on (**https://thatchers-techbase.github.io**).

Thatcher's Techbase is a *Doom 2* mod dedicated to the former British Prime Minister of the 1980s.

© © Internet Archive's Arcade Collection, doom

RETRO GAMING ON THE Pi

SET UP RETROPIE AND SET A COURSE FOR NOSTALGIC REVERIE.

Graphics weren't really up to much in 1981, but shaders can even make *Super Tank* look more beautiful.

There's been a resurgence in retro gaming lately. The C64 and NES (launched in 1982 and 1983, respectively) both saw mini editions launched back in 2018 and both enjoyed plentiful sales. A SNES edition appeared last year too, priced rather steeply at $265 (that's relatively more than the original's RRP). This was followed by the Amiga A500 Mini at the start of 2022 ($202 on Amazon).

All of the above are just open-source emulators running on commodity hardware in a designer shell, so you might think the prices are a little overboard. What you're paying for though, mostly, is the license to run these retro ROMs and disk images legally. Nintendo, in particular, will strike down with great vengeance if it catches you distributing any of its intellectual property. Just ask RomUniverse or **LoveRetro.co**. They might sue us for saying that, so we won't mention their name again.

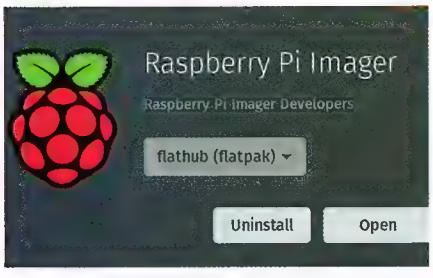
But there are a huge number of titles spanning the past five decades that you can run for free on cheap, modern hardware. If you have access to old tapes and disks, there are open-source solutions (of varying complexity) for extracting data from these, too. Running the emulators as they are will give you the best gaming experience and maximum customisation opportunities. And the Raspberry Pi is a great platform on which to do this.

There are plenty of OSes dedicated to retro gaming on the Pi, such as Batocera, Lakka, and Recalbox, however, we're going to focus on the excellent RetroPie. You don't need much beyond a Pi, SD card, keyboard and monitor to get started, but for an authentic feel, we'd recommend some sort of controller. You can even get one styled after your favourite console from any respectable Pi peripheral peddler.

No 20 cents required

If you want to go all out though, get yourself a Picade mini arcade cabinet from Pimoroni. The good pirate-monkey-robot-ninjas at the Pi emporium were good enough to send us one, and we can honestly say it's a marvel of engineering. It will take a couple of hours to build, but there are comprehensive instructions (**https://learn.pimoroni.com/article/assembling-your-picade**). Once you've built it, you can play games on its eight- or 10-inch screen with a quality joystick and six brightly colored buttons for bashing. The act of putting in coins is replaced by pushing another button. There's a power button too,

SETTING UP RETROPIE



1 DOWNLOAD PI IMAGER

We usually recommend Balena Etcher for these tasks (and it's a reasonable choice here too), but this time we'll use the official Raspberry Pi Imager. You'll find it in the Ubuntu Software Centre (or repos under rpi-imager), Flathub, or straight from the Pi Foundation website at **www.raspberrypi.com/software**.

2 DOWNLOAD RETROPIE

Open the Imager program and select Choose OS. You'll find RetroPie in the Emulation and game OS category. If you're using a different imaging program you can download the image directly from **https://retropie.org.uk/download**. You may need to gunzip it, depending on said imaging program.

3 BOOT THE SD CARD

Wait patiently for the image to be written and close whatever you used to write the media. The newly minted SD card will probably show up in your file manager. If so, it's safest to click the eject button there (even if it results in an error message) before removing the card. Pop it in your Pi and you're ready to go!

which can initiate a graceful shutdown if things go weird.

Whatever your setup, the first task is to write a RetroPie to an SD card (see steps, below left). Note that there are different versions for different Pi models (as well as Odroid boards). You don't need a keyboard plugged in if you have a controller, but you do need a screen of some sort.

If you're planning on using a funky kind of screen (such as a Hyperpixel HAT) you'll need to set that up with a regular display and keyboard first. If you're using the Picade you'll need a USB keyboard to set up the controls (press F4 to access the terminal and download the magick script).

To download setup scripts you'll need to either plug in an Ethernet cable or set up Wi-Fi, too. To set up the latter, skip to the terminal and run

```
sudo raspi-config
```

Then skip to 1 System Options>Wireless LAN. You'll need to set the wireless regulatory domain (regdom) to your country before networks are detected. On the first boot, the filesystem is resized to occupy the whole SD card, necessitating a reboot. On the second boot, you should see the RetroPie splash screen and soon after you'll be invited to configure controllers. Hold down any button on the controller (like it tells you) to start. Controls are based on a SNES-like controller, but if you have more (or fewer) buttons it's not the end of the world. The Picade controls are detected as a keyboard, so don't be alarmed (the inputs are converted by the Picade HAT into emulated keystrokes).

The final button, described as Hotkey Enable is important because (in the absence of a keyboard) it, in combination with other buttons, will enable you to configure RetroArch. The 'home' type buttons (such as the X on an Xbox-style controller) are useful here. If you're all out of buttons, the docs (**https://retropie.org.uk/docs/First-Installation**) recommend using the Select button here.

If you mess up the controller configuration (and save it), you might find yourself unable to navigate the menus. You can plug in a keyboard and use that to reconfigure the controller. Push Esc to display the main menu, then go to Configure Input and press Enter.

Legal ROMs

RetroPie doesn't include any ROMs out of the box, so initially, you're only presented with configuration options. RetroPie does helpfully set up Samba though, so you can copy content over without removing the SD card. The ROMs share should appear in your File manager on another PC connected to the LAN. Inside you'll see folders for the many platforms supported by RetroPie.

To test things out we'll grab a ROM (legally!) from the MAME site. Go to **https://mamedev.org/roms** and find *Super Tank* (in the Other Games section at the bottom). Or choose something else, everything on this page should work well. Check the box (assuming you agree to not use the title

Pimoroni's Picade is the best way to enjoy Pi-based retro gaming.

commercially) and download the supertnk.zip file. Don't unzip it, but place it in the arcade/ directory in the ROMs share. Restart EmulationStation by pressing Start to bring up the main menu, then selecting Quit, then choose the first option. You should now see a new Arcade option, which is for ROMs that run under MAME or FBNeo (FinalBurn, suitable for older arcade titles). The default RetroPie install includes multiple versions of both of these, and when you select the Arcade category and choose Super Tank, you'll be asked to choose one as the default. A reasonable choice here is

```
lr-mame2003
```

This should provide good overall compatibility for any arcade games you come across.

All going well, you should see the glorious, square-screened *Super Tank* introduction. Hit Select several times to furnish yourself with credits, then push Start to begin. The goals are simple: collect the yellow Xs, avoid the red ones, eliminate the red tanks and try not to get shot. A two-player mode is available if you have a friend, enemy, or if you simply enjoy shooting defenseless targets.

Other MAME versions (besides the three listed) are available in RetroPie. Some of these need to be installed separately. For example, the 2010, 2015, and 2016 editions are more suited to 'modern' games but may struggle on anything less than a Pi 4, whereas Mame4all should work even on a first-edition Pi (although it's considered outdated).

These and other emulators can be added from the RetroPie configuration menu (in RetroPie Setup> Manage Packages>opt). You can read more on the multitudes of MAME editions by visiting **https://retropie.org.uk/docs/MAME**.

THOSE MAGNIFICENT MACHINES OF THE 1980s

THE EIGHT-BIT MACHINES MANAGED TO DO A HUGE AMOUNT WITH LITTLE MEMORY AND CPUS THAT COULD BARELY COPE WITH LONG DIVISION.

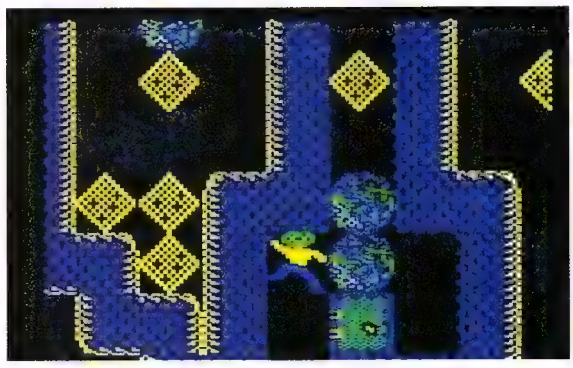
The Pi A and Pi B monograms are a tribute to the BBC Micro, which also came in a modest A form (with 16KB of RAM) and a beefier model B (with 32KB). That seems reason enough to devote time to emulating those bastions of British engineering.

BeebEm, mentioned previously, isn't included in RetroPie, and nor is it available through its experimental package repos. There have been a few attempts to write custom installers to get it to work. The easiest one is detailed at **https://bit.ly/lxf295-beebem**. You only need to install the MAME standalone and LR-Mess (non-arcade) emulators to get a virtual BBC B working.

You'll also need to put source some ROM files to make this work. These go in /home/pi/RetroPie/BIOS/mame. And no, we don't know where to get them. You can find disk and tape images at **www.bbcmicro.co.uk/index.php**, however. You'll need to boot these manually, and seeing as modern keyboards don't have a break key an old-school command line is required:

*exec !boot

To further confuse things, the asterisk is generated with Shift and '. There is a standalone BBC emulator, BeebEm, and is available for many platforms. But this doesn't build, or at least we couldn't get it to, on modern Linux. You can, however, emulate the BBC on another platform. One of the first alternative operating systems to appear on the Pi was a port of RISC OS, originally written for the first ARM processor on the Acorn Archimedes. You can find out all about it at **www.riscosopen.org**. We don't have space to cover it here, other than to say it can run the Beebit emulator without too much fuss.



If you can get the BBC emulator working through Mess, the *Repton* soundtrack will be stuck in your head.

ANATOMY OF RETROPIE

RetroPie is itself just a bundle comprising Pi builds of Emulation Station (ES – the GUI frontend), RetroArch (a frontend which some of the emulators plug into, the one with the funky green retro menu in-game), and the emulators themselves. The emulators that integrate with RetroArch (or rather its libretro library) are known as "libretro cores".

The glue that binds everything together, in a sense, is the RetroPie Setup Script. This is what handles all the package management, including adding custom emulators as you might have done for the BBC Micro above, and as you might do for the Amiga and Atari ST over the page. It can also be used to augment a standard Raspberry Pi OS installation with RetroPie. That's what the first option ("Basic install") is for.

Another important script is Runcommand, which tells RetroPie which emulator and options with which to run a particular ROM. You can configure this by pushing any button when launching a game. Options can be set for a particular system, or in a ROM-specific way.

Spectrum

Spectrum emulation is more straightforward. The Fuse emulator is included in RetroPie and you can find games to download at **www.infinitefrontiers.org.uk/zx-spectrum-downloads**. Put the .z80 files in /home/pi/RetroPie/roms/zxspectrum and you should be able to start them from the menu. Spectrum games require keyboard control, but you can map joystick buttons to the keyboard from the RetroGUI in-game menu (summoned by hotkey-X).

Commodore 64

People are still creating demos and games for the Commodore 64. Often these use imaginative techniques to produce impressive effects that, according to conventional thinking, wouldn't be possible on such modest hardware. Even in its heyday many of the demos exploited undocumented features (okay bugs) in the 6502 CPU or VIC-II chip to do weird and wonderful things. Even if used within operational parameters, the VIC-II enabled inexpensive shifting of sprites, pixels, characters, bitmaps, and other regions. It was an improvement on previous systems where these things would, for the most part, have to be redrawn by hand.

If you see SID, tell him

The SID (Sound Interface Device) chip was ground-breaking at the time. Previous audio hardware wasn't much use for anything besides blips or beeps. SID introduced fine frequency control, which enabled 16-bit resolution and much more sonorous background music. Besides this perfect(ish) pitch, it had previously unseen synthesis abilities. The chip was capable of making four waveforms (square, sawtooth, triangular, and white noise) across three channels. Each channel could be modulated,

© BBC

multiplexed, or otherwise transformed, with the effect that there seemed to be many more than three channels.

Each channel has its own envelope, determined by Attack, Decay, Sustain, and Release (ADSR) settings. This makes it possible to simulate, say, organ key presses. There's a musical genre dedicated to including SID output in conventional music. The Swedish band Machinae Supremacy (**www.machinaesupremacy.com**) describes itself as "SID-metal". If you want to make your own SID tunes, check out GoatTracker (**https://sourceforge.net/projects/goattracker2** or see **https://retro64.altervista.org/blog/making-commodore-64-music-the-sid-and-goattracker** for a guide.

The VICE emulator isn't included in the standard RetroPie installation but is easy to install. Go to the RetroPie configuration, select RetroPie Setup and select "Manage packages", then "opt" and scroll down to find Vice in the list of emulators. Select it and choose to install a pre-compiled binary. Installing from source is possible too, which may be a newer version, but may also take a long time. This is also true for any of the emulators listed.

It can emulate not just the legendary C64, but the PET series (first launched in 1977), the VIC-20 (1980) as well as the post-C64 models (the C64DTV, C128, the Commodore Plus/4), and more.

It's easy to get started with VICE. You can find some impressive demos at **https://c64.ch**. Pick one and pop the zip file in /home/pi/RetroPie/roms/c64. Multi-disk affairs will need to be unzipped. You can configure VICE from its menu by pressing F12: swap disks, increase emulation speeds, or quit the emulator. You might also want to try the VICE libretro core, which you can find in the "Manage packages" menu. This one can be configured from Retroarch's menu. Both of these emulators have some useful options, for example, "Warp mode" loads games quicker, at the cost of some emulation accuracy. Modern, disk-based, demos in particular take a long time to load (as did disk titles on the original C64), so be patient. There's an "auto warp on load" option if warp speed affects the program. You may need to configure a keyboard controller for some titles, though this may be a little haphazard. You can summon an on-screen keyboard by pressing right shift or Select.

Jeff Minter released all his titles as freeware, including *City Bomb* for the ZX Spectrum.

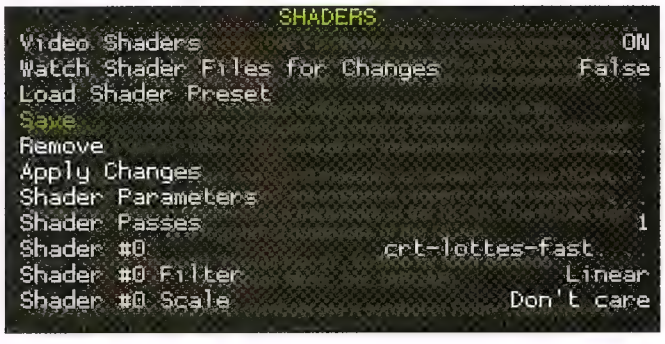
The C64's predecessors had the PetSCII character set instead of graphics. Try your hand at PetSCII art at **https://petscii.krissz.hu**.

MODERNISING GRAPHICS

Some of the machines we've emulated here did a lot with not many pixels. There's a certain charm to playing games at their original resolution, but on a powerful system, it's possible to do high-quality image resampling and upscaling.

Summon the in-game RetroPie menu and scroll down you'll find a submenu entitled Shaders. Select Load and you'll see a list of all kinds of graphical customisations (implemented as OpenGL Shaders) that can be applied. Try selecting the 2xScaleHQ preset. Now return to the quick menu (no need to restart the game) and select Resume. Those jagged edges are a lot less jagged, and the fonts are nicer too.

There are all kinds of filters available, and they're not all about improving the look. Some of them are quite demanding, especially on early model Pis. Some of them, however, have been designed to be sparing with resources. In particular, the crt-rpi* and crt-blurPi shaders were written to make authentic-looking cathode ray tube effects that even an original Raspberry Pi can manage. We noticed that our emulated Spectrum keyboard stopped working after changing shader settings, but returning to the controls menu (or restarting the game) seemed to fix it. If it's any consolation, much worse things happened somewhat regularly on the original hardware.

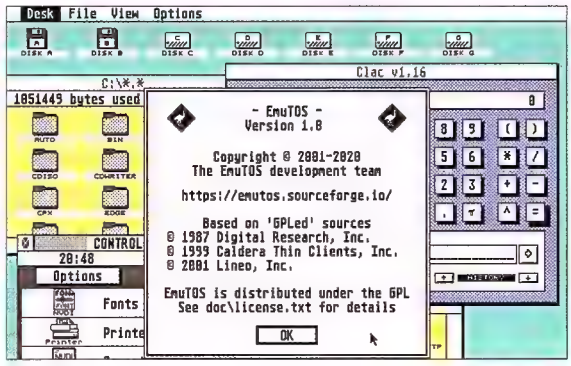


It's worth messing around with Retroarch shaders to improve the look of your games.

© Jeff Minter, RetroPie

16-BIT HITS

FOR MANY GAMERS, THE GOLDEN AGE OF COMPUTING WAS CHARACTERISED BY THE AMIGA 500 AND ATARI ST.



Atari TOS was superceded by MINT. Those are still copyrighted works, so here's EmuTOS.

Our favourite home computer was the Commodore Amiga, in particular the A500, which launched in 1987. As the successor to the immensely popular C64, the machine had big shoes to fill. And fill them it did – right up until questionable management effectively killed it off.

That said, Hyperion Entertainment produced a version of AmigaOS (**www.amigaos.net**) for PowerPC-based machines. A-EON technology, in collaboration with Hyperion, led to the AmigaOne X5000, the latest in a series of machines capable of running AmigaOS. These can emulate the Motorola 68000 at the heart of the first Amigas without batting an eyelid, though, at $2,500, you might say the X5000 is eye-wateringly expensive.

RetroPie 4.8 (the latest version at the time of writing) was released in March 2022, so some of its components, in particular some auxiliary pre-built binaries, are a little out of date. This can be worked around by building those components from source instead, which is what we're going to do to get Amiberry working. Go to RetroPie Setup>Manage Packages> Manage optional packages and select Amiberry>Install from source. It doesn't take long to build. On a Pi 4, it takes less time than making a cup of coffee. Once it's done, you'll want to reboot, using Restart System from the Emulation Station menu.

Amiga Format's 1993 Christmas Special featured a glorious *Cannon Soccer* mashup.

Above board ROMs

You should now see an Amiga option in the main ES menu. The Amiga Kickstart ROMs are still copyrighted but can be legally purchased from Cloanto's "Amiga Forever". You need these files to do almost anything with an Amiga emulator (although some demos can run with the free AROS ROM included with Amiberry). As well as that, you'll need some disk images (most commonly in the form of ADF images).

Some websites have been permitted by the original developers to distribute their games. For example, Team 17 titles are available from **http://dream17.abime.net** and Gremlin games are available at **http://gremlinworld.emuunlim.com/amiga.htm**. And of course, *Amiga Format*/*Power* cover discs from back in the day are easy to find.

Place your Kickstart ROM(s) in /home/pi/RetroPie/BIOS and ADF/IPS disk images in /home/pi/RetroPie/roms/amiga (these paths are the bios/ and roms/amiga/ Samba shares if you're copying over the LAN). These paths were also set incorrectly on the first boot when we tried, so you may need to plug in a keyboard and hit F12 to set them correctly and then hit the Rescan Paths button to pick up the changes.

Navigating the Amiberry configuration is a little tricky with just a game controller, and even using a keyboard it's not ideal, so you probably want to plug in a mouse too. If you're going to be playing Cannon Fodder, Populous, or other such classics you'll need one anyway.

One of the most exciting developments in the Amiga's history was Blitz BASIC. An edition appeared mounted to the cover of *Amiga Format* in November 1993, along with a zombie apocalypse game programmed in the language. Blitz BASIC soon unseated AMOS as the best way to program games, thanks to its simple(ish) BASIC-like syntax combined with advanced graphical capabilities.

The superior Atari ST

The Atari 520ST (and in particular the STFM variant) was a fine machine indeed. It just wasn't quite as cool as the Amiga. However, it had some neat features, such as the built-in MIDI interface,

and the STFM's 720K disk format being almost compatible with MS-DOS. It was popular enough to warrant a magazine with a title ending in "Format", too.

You can install the Hatari (Swahili for "danger" and the title of a John Wayne movie, incidentally) emulator in the same way as you did for Amiberry on the previous page. Again it's worth installing from source to get the latest version, but the binary package worked fine in our limited experiments.

Disk images go in RetroPie's roms/atarist/ folder. As with other systems, you'll need a BIOS ROM too. The Atari's OS was called TOS (The Operating System, or Tramiel Operating System) and is still a copyrighted work.

However a legal and open-source equivalent (based in part on sources made available by Digital Research) named EmuTOS is available, which you can find at **https://emutos.sourceforge.io**. There are different ZIP archives for different models, and we'd recommend the emutos-512k-1.2.1.zip version to get started. Inside you'll find country-specific images. For example, the US edition is named etos512us.img. Extract this file (or whatever locale best suits you), rename it tos.img, and put it in the bios/ share. To get the controls working in-game, press F12 to bring up Hatari's main menu. In the Joysticks section select either the "keyboard" or "real joystick"

In addition to the ST series, Hatari can emulate its more advanced, 32-bit successors – the TT or Thirty-Two (Atari chose all the best acronyms) and the Falcon. The TT was intended to be a Unix machine, but it took some time for the Unix port to arrive, so that didn't work out so well. It wound up being used as a developer machine for the similarly ill-fated, Atari Jaguar.

The Falcon, by comparison, was a beast of a machine, which included a high-end digital signal processor (DSP) capable of wrangling signals above CD-quality sample rates. Not only that, but it featured a true-colour video chip, the VIDEL. Later versions included a 500MB hard drive, too.

And that ends this journey into computing history. Who knows, maybe in 30 years we'll be emulating *SuperTuxKart* and wondering why *Wayland* and *PipeWire* were ever a thing. We hope we've sparked your retro tech memories, and wish you well recreating them on modern hardware. ■

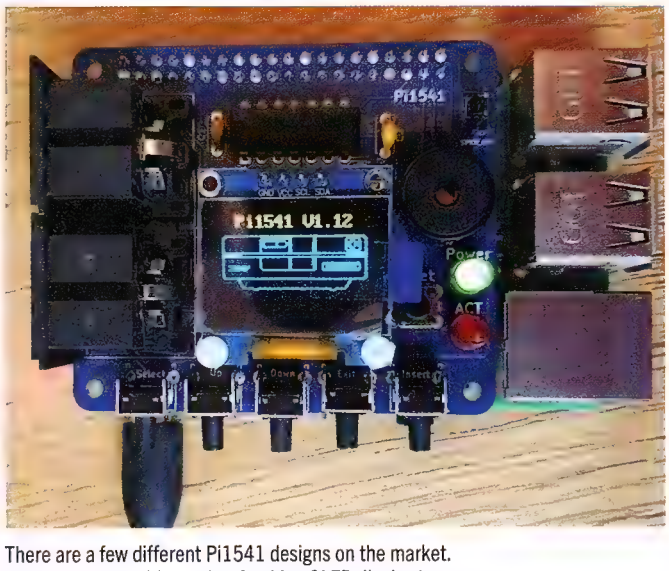
The Bitmap Brothers classic *Xenon 2: Megablast* featured a soundtrack by Bomb the Bass and a rather pushy sales alien.

RETRO-FITTING RETRO HARDWARE WITH RASPBERRY PI

Thanks to cheap hardware and people's unabashed inventiveness some really amazing peripherals are now available if you still have any working (or almost working) hardware laying around.

First of all, there's PiStorm. This fantastic (and open hardware) board, the work of Claude Schwarz, sits in between the 68000 slot on the Amiga mainboard and a Raspberry Pi. So instead of chugging along at 7MHz, your Amiga will be running an emulated 68EC030 running at around 70-80MHz. Furthermore, the Pi can share up to 128MB of its memory, which the Amiga sees as "Fast RAM", as opposed to the Slow RAM expansions we all had to save up $50 for in the 1990s. You can track down PiStorms on eBay for around $50.

Another fantastic device is the Pi1541. C64 fans might recognise those four digits from Commodore's 1541 external disk drive, which is exactly what it emulates. Unlike the original, it's neither noisy, slow nor cumbersome. It enables you to load 170kb disk images from an SD card, ideal if your 1541 has chugged its last. Read more about the Pi1541 at **https://cbm-pi1541.firebaseapp.com**.



There are a few different Pi1541 designs on the market. This one comes with a rather fetching OLED display too.

PC BUILDER

From the front lines of the Australian PC market

System news

Nvidia is finally doing something about pricing, or so Mark Williams hopes.

The technology restrictions on top-tier AI processors that America recently imposed on China was expected to cause a bit of a stir in the GPU market, with the likes of Nvidia's RTX 4090 caught up in the ban. The result was that available stocks of RTX 4090s would be shipped in volume to China from current global stocks, while they are still able to saturate sales there and take advantage of higher prices due to demand from those getting in before the ban was enforced.

While word is that indeed happened, it doesn't seem to have had a very drastic effect so far on local stocks here in Australia. While at some stores all SKUs of the RTX 4090 have sold out, at others it remains available and in multiple varieties at that. Most fortunately the rapid demand for them in China hasn't increased prices here, seeing perhaps only an increase of $100 since last month. It could be Australia got a little lucky due to our distance from the rest of the world, insulating us from anyone wanting to take advantage of this brief opportunity by shipping stock to China.

For the rest of the world as it stands the RTX 4090 is the clear performance king of this generation and Nvidia, unchallenged, doesn't feel the need to waste any more AD102 silicon (that the RTX 4090 uses) into the consumer market while the AI boom is still going particularly when it can charge ten of thousands of dollars for the same silicon in a professional card.

That's not to say that everything below that in the lineup is doing well. In fact, quite the opposite. Nvidia's typically popular 80 series have been selling terribly this generation with the RTX 4080 offering atrocious value for its performance and as a result gamers have been avoiding it like the plague.

In fact, most of Nvidia's lineup, while performant, typically are hamstrung by less-than-ideal VRAM capacities and tough to swallow pricing.

To remedy this, early next year Nvidia will launch the RTX 4000 Super series. If the current whispers are to be believed it'll focus on the mid to upper tier, with an RTX 4080 Super, RTX 4070 Ti Super and RTX 4070 Super.

The RTX 4080 Super should come in a little cheaper than the current RTX 4080, have a fully unlocked AD103 die and have faster VRAM resulting in an overall performance increase of about 10% and will become Nvidia's top SKU it can legally sell into China.

The alleged RTX 4070 Ti Super will also have an AD103 die at its heart with 8,448 CUDA cores enabled, putting it somewhere between the RTX 4070 Ti and RTX 4080 for performance while importantly still rocking 16GB of VRAM.

Then there's the RTX 4070 Super which is supposed to have 7,168 CUDA cores on an AD104 die, putting it just behind the RTX 4070 Ti for performance.

Certainly, for the RTX 4080 Super to fix the problems of its earlier brethren it needs to sell for closer to the RX 7900 XTX's price which has been selling well globally in comparison, so locally closer to $1,800. The other benefit of the new Super series is that it should push all the other RTX 4000 series cards down in price as well. Looking forward to that.

And with AMD not likely to release anything new until its RX 8000 series it'll mean AMD can only react with price cuts, further benefiting customers looking to buy early next year.

Mark Williams is an IT professional with a strong interest in voiding warranties.

Market Watch

A sampling of PC systems available this month

CENTRECOM KARUZA GOBLK

$1,699

tinyurl.com/APC528gob

As far as value goes, it doesn't get much better than this. Housing the best budget CPU from last year gets us off to a good start, especially as it's paired with a roomy 32GB of RAM for extra system longevity. The star of the show is the RTX 4070 which at this price point is great to see and will easily drive any game at 1440p at high refresh rates.

The amount of storage is also decent at 1TB. Potentially the weakest part of the system is the H610-based motherboard which gets by with enough of the basic connectivity options but nothing else.

Overall a very good value system for gamers on a budget.

CPU Intel 12th Gen Core i5-12400F; **COOLER** Thermaltake UX100 ARGB; **MOTHERBOARD** MSI PRO H610M-G WIFI DDR4 **GRAPHICS** PNY Verto GeForce RTX 4070 12GB GDDR6X; **MEMORY** 32GB Kingston Fury Beast RGB DDR4 C16 3200MHz; **STORAGE** 1TB Kingston SNV2S NV2 PCIe 4.0 NVMe M.2 SSD; **POWER SUPPLY** Antec CSK650 AU 650W **CASE** Antec DP301M ARGB.

ALLIED PC PATRIOT-I

$1,899

tinyurl.com/APC528pat

Coming in $200 dearer than the CentreCom system, this certainly looks the prettier of the two thanks to the dual-tone colour scheme. It has the same good-value CPU, SSD and PSU capacities though gets a higher-grade motherboard for some extra IO connectivity.

However, there are two large marks against this system compared to the CentreCom one. This only has 16GB of RAM and the GPU is a previous-gen RTX 3070. While the RAM could be overlooked if you're a light user, the RTX 3070 is straight up 20% slower in games. For a more expensive product, that makes this system a tough sell unless the aesthetics are important to you.

CPU Intel Core i5 12400F; **COOLER** Allied Sidewinder ARGB 120mm air cooler; **MOTHERBOARD** Intel B660 DDR4; **GRAPHICS** Nvidia GeForce RTX 3070 8GB; **MEMORY** 16GB 3200MHz DDR4 RGB; **STORAGE** 1TB Gen 4 NVMe M.2 SSD; **POWER SUPPLY** 650W; **CASE** Allied Patriot.

PC CASE GEAR INFERNO 7800 XT

$2,399

tinyurl.com/APC528inf

Sitting in the price-to-performance sweet spot, this system ticks a lot of good boxes. Starting off with the CPU, it may be the cheapest AM5 processor available but it's only a hair slower than the Ryzen 5 7600. It's matched with 32GB of some AMD-friendly fast DDR5. It has two SSDs for a total of 1.5TB of mass storage, and sports an RX 7800 XT which equals last generation's top performing cards.

The motherboard should support several generations of CPU upgrades and the cooler, while stock, is more than sufficient for this system while also keeping costs down. A well-rounded system.

CPU AMD Ryzen 5 7500F; **COOLER** Wraith Stealth OEM; **MOTHERBOARD** Asus TUF Gaming B650M-E Wi-Fi; **GRAPHICS** PowerColor Radeon RX 7800 XT Red Devil OC 16GB; **MEMORY** 32GB Team T-Force Delta 6000MHz CL38 DDR5 RGB **STORAGE** 500GB & 1TB Team Cardea Z44L M.2 PCIe Gen4 NVMe SSDs; **POWER SUPPLY** Kolink Regulator 850W; **CASE** Kolink Observatory HF ARGB Mesh.

BPC TECH SIREN VORTEX BF23

$2,399

tinyurl.com/APC528sir

At the same price as the PC Case Gear rig, this also offers substantial performance for the price. Most notable is the RTX 4070 Ti which will push games 15% faster compared to its competitor, and on top of that the i5-13600K CPU has more multithreading grunt than the R5 7500F, meaning better multitasking or productivity.

It also sports an AIO cooler, which is much needed for Intel's latest hot and sweaty processors. With the same RAM and PSU capacities and an acceptable 1TB of SSD storage, this system of the two offers more bang for your buck.

CPU Intel Core i5 13600K; **COOLER** Valkyrie A360 360mm AIO; **MOTHERBOARD** MSI B760M Bomber WIFI; **GRAPHICS** PNY Nvidia GeForce RTX 4070 Ti 12GB GDDR6X XLR8; **MEMORY** 32GB Corsair Vengeance DDR5 5200MHz CL40; **STORAGE** Lexar 1TB Gen4 SSD; **POWER SUPPLY** MSI MAG A850GL 850W; **CASE** Asus A21.

Blueprints

Value- and performance-driven hypothetical builds

Budget. A perfect balance between price and performance.

The term 'budget' used in this sense is to depict our lowest value build, yet all of our blueprint builds have a so-called budget. Thankfully for us, this is virtual, and we can play around with said so-called budget as much as we like. What happens next is a balanced selection of equivalent components to fit each build, and this lower-tier machine is the most money-conscious of the bunch. Despite this, it still offers modern parts, with good performance and plenty of room for upgrades down the line.

"We are getting rid of the former Micro-ATX motherboard for a larger, more compatible board, the ASRock Z690 Phantom Gaming 4/D5."

The main captain of the ship, the Core i5-12400F, has dropped by $10, and its newly added right-hand man, the Zotac GeForce RTX 4060 Ti GPU, has remained at the same price. However, what it is seated on has changed. We are getting rid of the former Micro-ATX motherboard for a larger, more compatible board, the Asrock Z690 Phantom Gaming 4/D5. At $219, it's worth the extra $20 to bring more futureproofing to our machine. We had to swap our DDR4 RAM for some TeamGroup T-Force Vulcan DDR5 sticks. These are faster, running at 5200MHz – the PNY XLR8 Gaming Epic-X RGB sticks had speeds of up to 3600MHz. These sticks are available on Amazon's Australian site. Other than that, the Intel build stayed the same.

Sailing over to destination AMD, as we mentioned before, this receives the same PSU treatment as the Intel machine. We brought in the Sapphire Pulse AMD Radeon RX 6700 XT 12GB last issue to boost the overall gaming appeal of this machine and bring it up a notch from the previous GPU. However, with no price changes on this or any other component, we are happy with how this AMD machine is sitting, so are not making any changes.

AMD BUILD - Approximate Price $1,408

Case	Corsair 4000D Airflow	$149
PSU	600W EVGA 600 BR 80+ Gold	$79
Mobo	MSI B550M PRO-VDH WIFI Micro ATX AM4 Motherboard	$129
CPU	AMD Ryzen 5 5600	$209
GPU	Sapphire Pulse AMD Radeon RX 6700 XT 12GB	$559
RAM	16GB (2 x 8GB) PNY XLR8 Gaming Epic-X RGB DDR4 @ 3600MHz	$89
SSD	1TB Lexar NM790 PCIe 4.0 M.2 SSD	$65
HDD	2TB Seagate Barracuda Compute 7200	$69
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

INTEL BUILD - Approximate Price $1,616

Case	Corsair 4000D Airflow	$149
PSU	600W EVGA 600 BR 80+ Gold	$79
Mobo	NEW **Asrock Z690 Phantom Gaming 4/D5 ATX LGA1700**	**$219**
CPU	Intel Core i5-12400F	$225
GPU	Zotac Gaming GeForce RTX 4060 Ti 8GB Twin Edge OC	$629
RAM	NEW **16GB (2 x 8GB) TeamGroup T-Force Vulcan DDR5 @ 5200MHz**	**$121**
SSD	1TB Lexar NM790 PCIe 4.0 M.2 SSD	$65
HDD	2TB Seagate Barracuda Compute 7200	$69
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

AMD BUILD - Approximate Price $2,486

Case	Nzxt H7 Flow	$199
PSU	750W EVGA 750 G5 80+ Bronze	$179
Mobo	**MSI B650 Gaming Plus Wi-Fi ATX AM5**	**$339**
CPU	AMD Ryzen 5 7600X	$389
Cooler	MSI MAG Coreliquid 240R V2	$129
GPU	XFX Speedster Swft 319 Radeon RX 6800	$888
RAM	32GB (2x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	$169
SSD	1TB Lexar NM790 PCIe 4.0 M.2 SSD	$65
HDD	2TB Seagate Barracuda Compute 7200	$69
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

INTEL BUILD - Approximate Price $2,687

Case	Nzxt H7 Flow	$199
PSU	750W EVGA 750 G5 80+ Bronze	$179
Mobo	**Asrock Z790 PRO RS WIFI ATX LGA 1700**	**$369**
CPU	Intel Core i5-13600K	$499
Cooler	MSI MAG Coreliquid 240R V2	$129
GPU	Zotac Gaming RTX 4070 Twin Edge DLSS 3 12GB	$949
RAM	32GB (2x 16GB) Corsair Vengeance DDR5 CL40 @ 4800MHz	$169
SSD	1TB Lexar NM790 PCIe 4.0 M.2 SSD	$65
HDD	2TB Seagate Barracuda Compute 7200	$69
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

Mid-range. A game-ready machine that can also handle demanding work.

From solid 1080p gaming, we now leap upwards to QHD territory with our mid-range builds. Here, we have a larger virtual pit of money to amp up the overall performance of our PCs. As with most custom PCs, choosing the GPU can be the most time-intensive part of the journey – finding one at the right price and then often building the rest of the machine around it. We did feature a Radeon RX 7800XT in this section not so long ago thanks to a bit of a crazy sale, but last issue we had to say goodbye and bring in a cheaper RX 6800 to fill the space. With no price alterations since then, the XFX Speedster SWFT 319 Radeon RX 6800 is still our GPU of choice for the AMD mid-range.

"As with most custom PCs, choosing the GPU can be the most time-intensive part of the journey – finding one at the right price and then often building the rest of the machine around it."

The brains for the AMD system also remain the same – taking the hot seat is the AMD Ryzen 5 7600X. It's a competent and powerful CPU for gaming and productivity-based tasks, especially for the price. One thing we wanted to do was replace the Micro-ATX board, just like we did for the Intel budget PC, swapping the Asrock B650M PG Riptide Wi-Fi Micro ATX for the MSI B650 Gaming Plus WIFI ATX. This will bring more room for fans, additional storage, and improved longevity.

The prices for GPUs on the Nvidia side have been dropping slightly more than the Radeon lineup. As we are using the Nvidia range for our Intel systems, this certainly is a pleasant sight. You can now get an RTX 4070 for just over $900. We have the Zotac Twin Edge RTX 4070, which we introduced last issue, as this is one of the cheapest at $949.

The only change on the Intel mid-range build was another motherboard swap – a marginal upgrade to the Asrock Z790 Pro RS WIFI. It's a more visually interesting board than the previous Gigabyte Z790 UD AC ATX. The latter certainly had a cheaper look to it, and for an extra $10, the swap was worth it.

High-end. A game-ready machine that can also handle demanding work.

Our Turbo machines don't tend to see as many alterations or sales as the other two tiers in our Blueprints section. This is generally due to us reaching a certain performance point and waiting for greater components to come out. Sales are rare, as these are much more sought-after components. This time though, we do see a fair few changes to our top-end rigs.

Something that helps bring on price reductions is the release of new generations. Speaking of, we can now bring in Intel's latest flagship 14th-gen i9 chip, the i9-14900K. Although this is the latest and technically the greatest from Intel, it shouldn't discredit the i9-13900K or KF variant it supersedes, as they are still speedy chips. Regardless, it's an improvement.

"Both of these Intel Turbo build changes will be sitting on a fresh new motherboard, Gigabyte's Z790 AorusS Elite AX."

This chip is paired with the RTX 4090, still the best GPU on the market, but unfortunately, its value has risen above $1,500. Our previously chosen Zotac GeForce RTX 4090 Gaming Trinity OC has crept up in price. Now, we can meet its replacement, the PNY XLR8 Gaming Verto Epic-X RGB OC. This is $2,999, which is still overpriced, but one of the cheapest, relatively speaking.

Both of these Intel Turbo build changes will be sitting on a fresh new motherboard, Gigabyte's Z790 AorusS Elite AX. A premium build needs a premium motherboard – the previous Gigabyte Z790 UD AC ATX didn't quite live up to those standards, so we saw it as time to make the change. Hopefully, we will see some price changes for the RTX 4090 GPU, but for now, we are happy with our top offering on team Intel.

On the AMD powerhouse rig, things aren't as exciting. We are keeping our motherboard, as it's still very relevant and premium. Also, the pairing of the AMD Ryzen 9 7950X3D and AMD Radeon RX 7900 XTX is still our selected lineup. We've saved $90 on the processor from the last issue, and have kept the Sapphire Pulse Radeon RX 7900 XTX 24GB.

AMD BUILD - Approximate Price $4,801

Case	Phanteks Enthoo Pro 2 Tempered Glass	$299
PSU	1000W Nzxt C1000 80+ Gold	$239
Mobo	Asrock X670E PG Lightning ATX AM5	$449
CPU	AMD Ryzen 9 7950X3D	$999
Cooler	Nzxt Kraken X73 RGB 360mm	$329
GPU	Sapphire Pulse Radeon RX 7900 XTX 24GB	$1,659
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	$279
SSD	2TB WD Black SN850X M.2 PCIe 4.0	$309
HDD	6TB WD Blue 5400 HDD	$179
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

INTEL BUILD - Approximate Price $5,961

Case	Phanteks Enthoo Pro 2 Tempered Glass	$299
PSU	1000W Corsair RM1000x Shift 80+ Gold	$239
Mobo	**NEW** **Gigabyte Z790 Aorus Elite AX ATX LGA1700**	**$339**
CPU	**NEW** **Intel Core i9-14900K**	**$929**
Cooler	Nzxt Kraken X73 RGB 360mm	$329
GPU	**NEW** **PNY XLR8 4090 Gaming Verto Epic-X RGB OC 24GB**	**$2,999**
RAM	64GB (2x 32GB) Corsair Vengeance DDR5 CL40 @ 5200MHz	$279
SSD	2TB WD Black SN850X M.2 PCIe 4.0	$309
HDD	6TB WD Blue 5400 HDD	$179
OS	Windows 10 Home 64-bit OEM (Windows 11 Compatible)	$60

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The problem solvers

The *APC* team field problems across the spectrum of devices and software. Learn a new trick or fix you can use.

Overclocking conflict

I reinstalled my old RX 570 graphics card in a rig for my brother, and wanted to give him a free speed boost as an extra present. While I can overclock the memory to 1,750 MHz with MSI Afterburner, if I install AMD's Adrenaline on to the system, it'll crash – black screen, followed by the PC freezing. However, if I raise the voltage controller memory setting in Adrenaline before applying the change in Afterburner, it works okay. Why is it doing this? No voltage settings are required when it's just MSI Afterburner installed.
Phil Strader

APC Responds: This sounds like a classic software conflict where one application (Adrenaline) overwrites the changes of another (Afterburner), resulting in the problems you've experienced. Ultimately, Adrenaline is optimised for AMD cards, so there's no reason to use Afterburner – instead, remove it and overclock using Adrenaline to see if you can achieve the same results without Afterburner.

If you go down this route, you may want to experiment with some other tools that don't conflict with Adrenaline – Fan Control (**https://getfancontrol.com**) does a better job with custom fan curves for keeping your card (and the rest of your system) cooled, while HWiNFO64 (**www.hwinfo.com**) can monitor and identify which fan is which for Fan Control's benefit.

Secure messaging

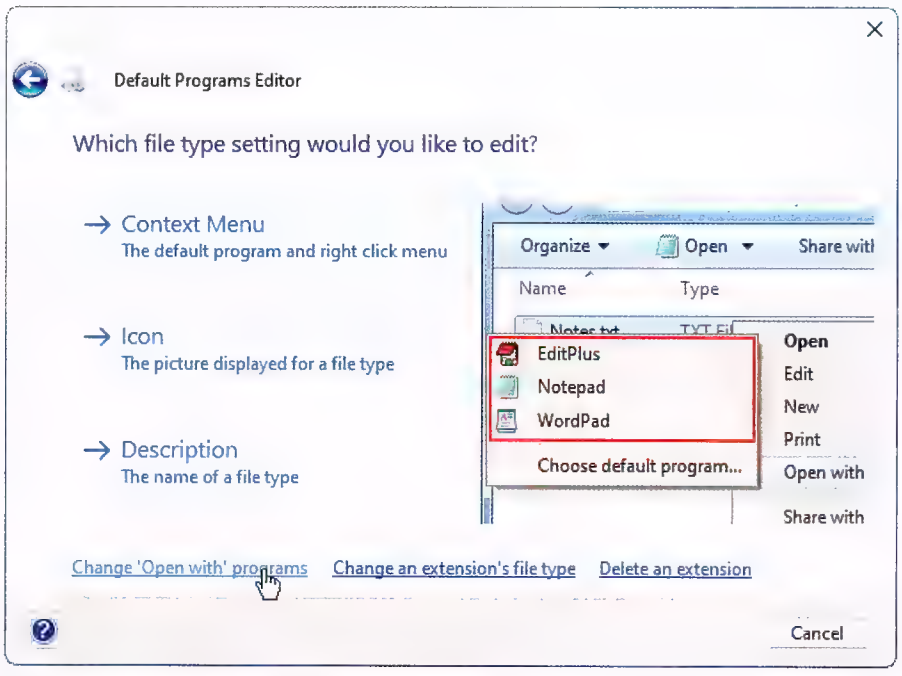
I'm on the hunt for a secure way to chat with friends and family – something that isn't likely to fall foul of law enforcement or requires any kind of personal identification to set up – which is why I ruled out Signal, because it requires a mobile phone. Can you suggest a suitable setup?
Damien Williams

APC Responds: The biggest hurdle in any switch to a more secure messaging platform is buy-in from your contacts. *APC* is spread across multiple platforms, preferring Signal for its privacy, but forced to compromise to stay in contact, so he hopes you're able to sell the solution you choose to your wider circle.

Ultimately, we're going to recommend a self-hosted solution, which you'd install on your own server and open to the internet through a dynamic domain or subdomain. Self-hosted doesn't necessarily mean more secure, but it does reduce the attack vector by making you less visible than when using a public messaging platform. Any self-hosted service with access through a domain is publicly visible, so make sure you keep it secure – use Docker/Podman where possible, as the service can at least be isolated inside its own container.

Self-hosted chat services aren't rare, but for personal use, you don't want to pay for the privilege. One interesting example that's not quite ready for prime time, but looks to offer your contacts a user-friendly, slick experience, is Snikket (**https://snikket.org**). The server can be deployed through Docker or Podman, then each friend or family member connects to it through their own Snikket mobile app. The issue here is that while the Android version is available through the Google Play store, you'll need to install TestFlight to beta-test the app on iPhone or iPad. There's also no desktop or browser-based client, although both are in the pipeline.

Another option is to build your own cloud storag. Our chosen platform – Nextcloud Hub – comes with built-in chat capabilities in the form of Nextcloud Talk, which allows you to connect to anyone with accounts set up on your specific Nextcloud instance, but no one else, which obviously helps block eavesdroppers. Your friends and family can connect through dedicated Nextcloud Talk apps for iOS and Android, or through their web browser. Find out more at **https://nextcloud.com/talk**, and if you go down this route, we strongly advise you enforce 2FA on any Nextcloud accounts you create to boost security.



This freeware tool makes editing default apps easy.

Broken app associations

I had to move my portable applications folder to another drive, but not only have I broken a file association (.7z files), the now-redundant program entry (7-Zip Portable) remains an

"While I can overclock the memory to 1,750 MHz with MSI Afterburner, if I install AMD's Adrenaline on to the system, it'll crash – black screen, followed by the PC freezing."

option in the 'Open with' menu. If the broken shortcut icon wasn't a giveaway, choosing this option has no effect, returning me to the 'Open with' menu. How do I remove these links or update them to point to the app's new location?
Mayra Kea

APC Responds: You'll find these entries in the Registry, Mayra, but thankfully there's a free tool that can repair the file association. Download Default Programs Editor from *https://defaultprogramseditor.com*. The utility is portable too, so simply extract its contents from the zip file and double-click Default Programs Editor.exe to get started.

Select 'File Type Settings', followed by 'Context Menu'. Select .7z from the list and click Next. With Open selected, click 'Edit Selected Command...', then click Browse to locate and select the 7-ZipPortable.exe program file from its new location. Click Browse next to 'Item icon', and you can re-select the app icon. Click Next, followed by Save Context Menu > OK > Close.

That fixes the primary problem when double-clicking the file, but you may find that the orphan entry remains alongside it under the 'Open With' menu. This is a problem specific to .7z files – the solution lies in opening Registry Editor and navigating to Computer\HKEY_CLASSES_ROOT\7z_auto_file\shell\open\command, where you'll find a value pointing to 7-Zip's old location. Delete the 7z_auto_file key, close Registry Editor, and then restart Windows Explorer (right-click the taskbar and choose Task Manager, then select the Windows Explorer entry before clicking 'Restart task'). The obsolete entry should be removed, leaving your now-working shortcut to as the only option for opening 7-Zip Portable.

Stop laptop dimming

My new laptop screen is a real pain – it must be set to adaptive dimming like my phone, as it's constantly increasing or decreasing the brightness depending on the light conditions to make it difficult to read. I'd like to control this manually – is there any way to do so?
Arthur Frisina

APC Responds: Open Settings and navigate to System > Display. Select Brightness and click the 'Help improve battery by optimising the content shown and brightness' dropdown to either switch adaptive brightness off completely or simply restrict its use to battery power.

Some desktop PCs have this feature – in this case, the option is usually marked 'Change brightness automatically when lighting changes'. If you can't find either feature, it's likely that adaptive brightness isn't supported; verify this by typing 'power' into the search box and clicking 'Edit power plan'. Click 'Change advanced power settings', expand 'Display > Turn off display after'. If there's no 'Enable adaptive brightness' setting, it's not supported.

Cleanup gone wrong

My Windows boot drive showed less than 5GB free space, so after a cleanup using BleachBit (freeing up 15GB), I decided to prune my installed apps, as I'd been trialing some software that was taking up gigabytes of space. Unfortunately, I used Bulk Crap Uninstaller's mass uninstall option, which led to Adobe Premiere Elements and Photoshop Elements' uninstallers complaining of not being able to work because of other uninstallers running. The result is a partially uninstalled program with no uninstaller entries. How do I fix this?
Harold P Borel

APC Responds: While it's tempting to simply delete the program folder or try some of BCU's manual removal tools, it's best to first try reinstalling the program over the top of itself.

When Harold came to try this, he received an error message telling him another uninstall process was running. We instructed him to open Device Manager, where he could see the presence of an Adobe Uninstaller process – right-clicking this and choosing 'End task' allowed the Photoshop Elements installer to run successfully. It detected a previous install (the partially removed version), and was able to install itself over the top.

Unfortunately, the installer failed to generate the required uninstaller entry in Windows or BCU, which left us with no option but to instruct Harold to open BCU and choose 'Tools > Uninstall by window, directory or file'. Click 'Link or application's file...' Browse to Program Files\Adobe\Photoshop Elements 2024 and select PhotoshopElementsEditor.exe. Click Open, then follow the same uninstall wizard – when the uninstall completes, perform the same step.

Once done, check the Program Files\Adobe folder for an Elements 2024 Organizer folder. Remove this in the same vein using BCU, this time targeting the file PhotoshopElements Organizer.exe.

Removing Docker Desktop

After reading your head-to-head on Podman over Docker, I've decided to switch. However, when I attempt to remove Docker Desktop from my Windows PC, it gets stuck at the 'Removing VM and Images' stage. I don't want to install Podman until Docker Desktop is gone – can you help?
William Huskins

APC Responds: Many people confronted by this problem have reported success by stopping the Docker Desktop Service prior to attempting removal – press Win + R, type services.msc and click OK. Locate the Docker Desktop Service entry, then right-click it and choose Stop. In William's case, the uninstaller moved on to hang at the next stage – deleting files – of the process. What finally worked was to open a Terminal window – right-click the Start button and choose Terminal (Admin) – and then issue the following command:

```
wsl --shutdown
```

This shuts down the Linux Subsystem engine Docker runs on, letting it complete the removal process. ■

Make Windows better

Expert tips for a better experience.

WINDOWS 11

Swap what your function keys do

Pressing the F1 to F12 function keys on laptops each perform two tasks. Which one it carries out depends on whether you hold down the Fn key at the same time. For example, pressing F5 mutes/unmutes audio, while pressing Fn+F5 refreshes a web page. If you want to reverse this, so pressing F5 refreshes web pages and documents, you'll need to change a setting in your BIOS.

You can access your BIOS when booting your laptop, though how you do so depends on your particular device – so have a look in the manual. Often pressing F10 or F12 repeatedly works. If not, try Delete or Esc.

What you need to do in the BIOS also varies, but in general click the Advanced tab then System Options. Next, change 'Launch Hotkeys without Fn Keypress' to Active. In other systems, you'll need to find the Action Keys option and change the default setting. We then clicked 'Save Changes and Exit' to reboot our system.

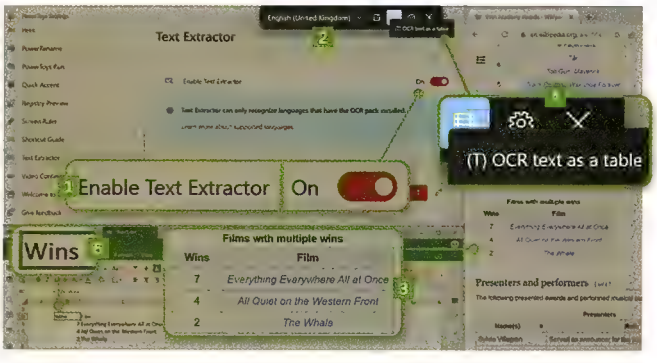
WINDOWS 10 & 11

Extract text from tables

The improved Text Extractor tool – new in version 0.74 of Microsoft's PowerToys – lets you extract text from a table and paste it into a tabular format, such as a spreadsheet.

Open PowerToys, click Text Extractor on the left, then Open Settings and make sure Enable Text Extractor is set to On (1 in our screenshot below). Next, press the Win+Shift+T shortcut to activate the tool – the screen will dim and a toolbar will appear at the top 2.

In our example, we wanted to copy from Wikipedia list of films with the most Oscar wins in 2023 3. We clicked the 'OCR text as table' icon 4 on the toolbar, then drew a box over the 'Films with multiple wins' table. Next, we pasted this table into cell B2 in our spreadsheet (we used OnlyOffice) 5 and adjusted the width of column C so we could see the film titles.



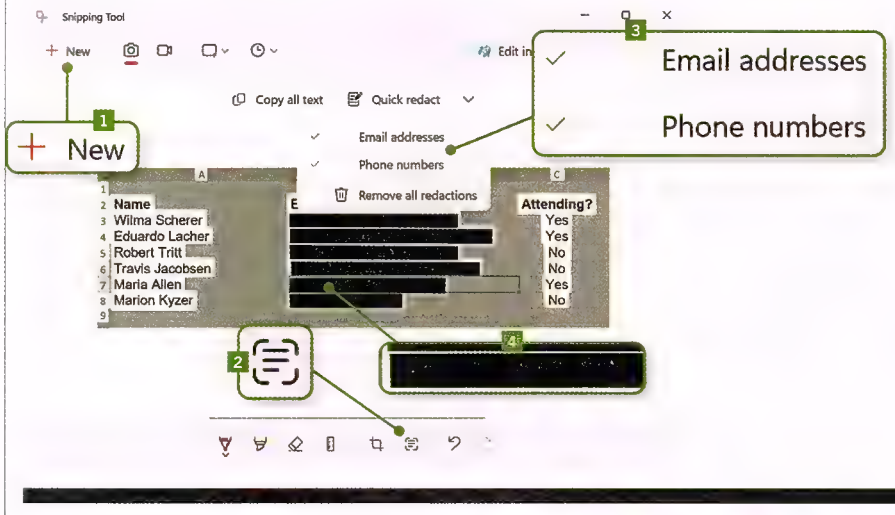
Windows 11

Redact contact information using Snipping Tool

Windows 11's 'Moment 4' update – released in September – improved Snipping Tool so that it automatically detects and redacts contact information in screenshots.

Open Snipping Tool then click 'New screenshot' icon (1 in our screenshot). In our example, we want to blank out the email addresses and phone numbers of party guests. Draw a box around the information you'd like to capture, then click the 'Text actions' icon 2. Snipping Tool will then highlight all the text it detects.

Next, select the 'Quick redact' dropdown menu and tick what you want to redact – 'Email addresses' or 'Phone numbers', or both 3. Finally, click 'Quick redact' and Snipping Tool will place blank bars over the contact information you chose 4.

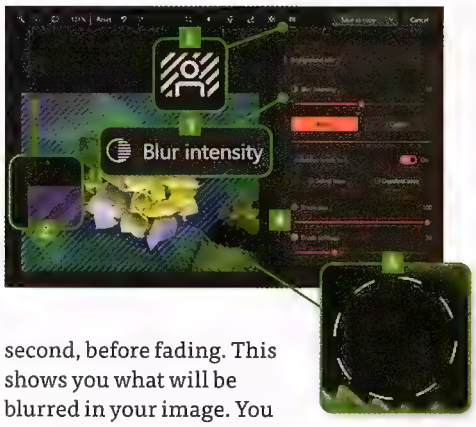


WINDOWS 11 INSIDER

Blur image background in Photos app

Windows Insiders can now blur image backgrounds in the Photos app. It's available in build 2023.11090.20015.0 or later on the Beta channel.

Open your image in the Photos app, then click 'Edit image' on the toolbar. On the new toolbar that appears click the 'Background blur tab' icon (1 in our screenshot above right). The app will detect your photo's background and highlight it in a multi-coloured striped selection 2 for a second, before fading. This shows you what will be blurred in your image. You can adjust the 'Blur intensity' slider 3 to your liking between 0 and 100, where 0 changes nothing. If you want to blur or unblur your background manually, turn on the 'Selection brush tool'. You'll now see the option to 'Select area' or 'Deselect area', as well as 'Brush size' and 'Brush softness' sliders 4. In our example, we've chosen deselect, before painting the lower-right corner of our image with a brush size of 100 5. When we clicked Apply the Paint app didn't blur this area. ■



Make Office better

Expert tips for a better experience

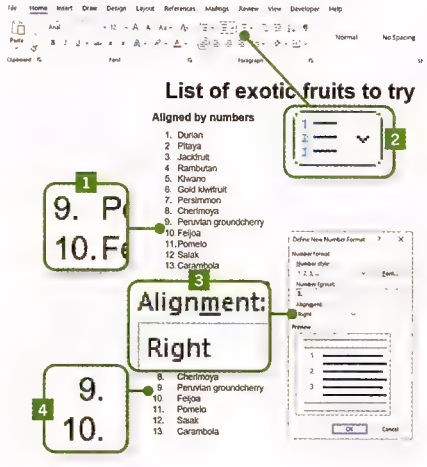
MICROSOFT WORD & LIBREOFFICE WRITER

Align numbers in lists by the full stop

When you make numbered lists, Word aligns them to the left. This means that the full stop gets pushed out when you move from 9. to 10. in the list (1 in our screenshot below). If you don't like this style, change the number so they're aligned by the position of the full stops instead.

Create your list then select it by clicking any of the numbers. Next, click the Home tab at the top, and in the Paragraph section click the dropdown arrow next to the Numbering icon 2. Click 'Define New Number Format...' to open the settings menu. Change the 'Alignment:' dropdown menu from Left to Right 3. Click OK. Your numbered list will now be aligned by the full stop 4.

To do this in LibreOffice Writer, first highlight your list, then click Format on the toolbar and select 'Bullets and Numbering...'. Click the Position tab then change the 'Number alignment:' dropdown menu from Left to Right. Click OK to confirm.

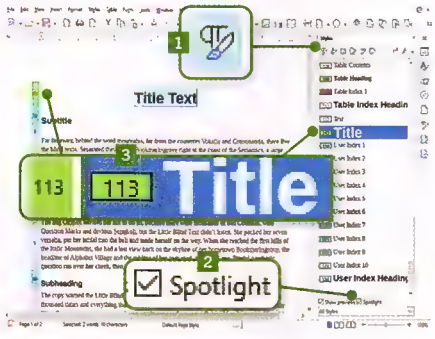


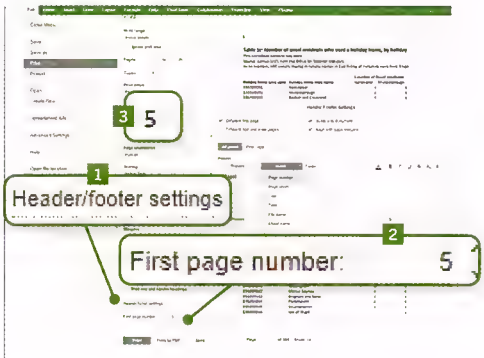
LIBREOFFICE WRITER

Check your document's styles

LibreOffice 7.6, released in August, added the Spotlight tool to the Style menu, which lets you see styles you've used across your document and switch quickly between them. This helps you identify a style, which isn't always easy in LibreOffice Writer because many of them look almost identical.

First, click the Styles icon on the right (1 in our screenshot below) to open the Styles menu. Now tick the Spotlight box at the bottom 2. In this view, LibreOffice assigns each style you've used in your document a specific colour and number, shown in the left margin. In our example, our main title uses the Title style, which is assigned a lime-green label of 113 in both the margin of our document, and the styles menu 3.





ONLYOFFICE

Set your first page number in spreadsheets

In OnlyOffice 7.4, released in June, you can choose which number you start counting from when numbering your spreadsheets. Labelling your first page as page 5, for example, would be useful if you're inserting your spreadsheet in the middle of a larger printed document, with pages 1-4 written in word-processing software.

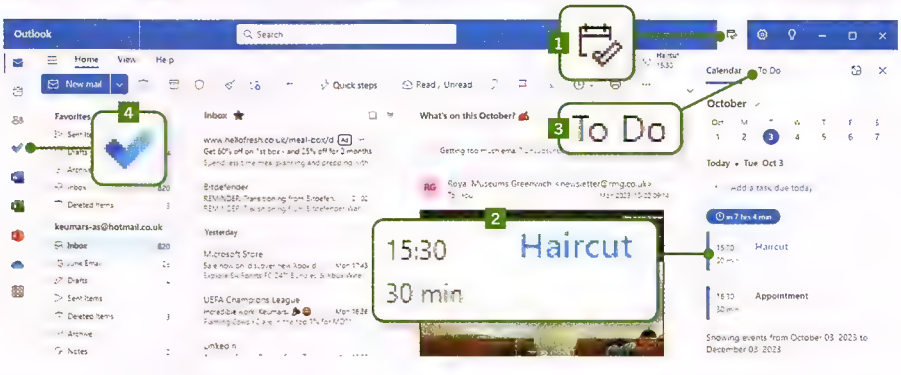
First, click File then Print on the left and on the right you'll see your print preview. Now click 'Header/footer settings' (1 in our screenshot above) and select one of the six boxes to choose the positioning of your page number – we selected top left.

Click the 'All pages' tab, then the Insert dropdown menu and select 'Page number'. Do the same for the 'First page' tab. Click OK. Next, in the 'First page number' box 2 below 'Header/footer settings', type the number you'd like to start counting from on the first page. In our example, we are counting from '5' – it appears at the top left of our document 3. ■

Microsoft Outlook

See calendar entries and to-do tasks in the same view

New in Microsoft's redesigned Outlook app is My Day, letting you see your to-do list and calendar entries in a single view. This comes installed on Windows 11 PCs, but Windows 10 users may have to install it from the Microsoft Store: **tinyurl.com/APC528cal**.



Click the My Day icon at the top-right (1 in our screenshot) to open a pane on the right side of your screen. By default, it opens in the Calendar view which lists all your entries for the day 2. You can also click the To Do tab 3 to view all the tasks you've created using Microsoft's To Do app (to-do.office.com/tasks/). To open the To Do app click the blue-tick icon on the left 4.

Browser tips

Secret settings and best extensions

EDGE

Recover lost favourites and fill forms faster

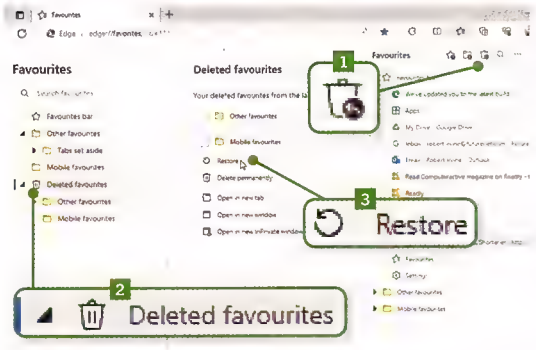
In the past year, we've frequently complained about Microsoft stuffing Edge with unnecessary features, so we're pleased that version 117 (released in September) removes some of this junk. The 'deprecated' tools include Maths Solver, Picture Dictionary, Citations and Kids Mode, and their removal makes the browser less cluttered and quicker to navigate.

The two new features in Edge 117 are genuinely useful additions. One is called Microsoft Edge Sync Favourites Recovery, and lets you recover 'favourites' (Microsoft's name for bookmarks) that you've accidentally deleted.

Provided you have Sync enabled in the browser, and are signed into your Microsoft account, you can now restore deleted favourites from the past 14 days.

To do so, click the Favourites button on Edge's toolbar (this looks like a star with three lines on it) and click the new 'Restore deleted favourites' option, which looks like a bin with a reverse arrow (1 in our screenshot below left). Alternatively, type edge://favorites in the search bar and open the 'Deleted favourites' folder 2. Right-click a deleted favourite or folder and choose Restore 3.

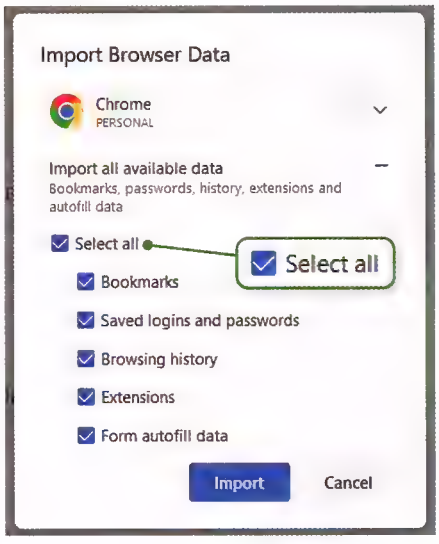
The other new feature is Autofill Autocomplete, which saves you time when filling in online forms. When you start typing in a form field, Edge will automatically detect whether matching data – such as your address – is stored in the browser, and complete it for you. You can manage your saved autofill information at edge://settings/personalinfo.



BRAVE

Make web pages easier to read

When we reviewed Brave, one useful tool we didn't have space to mention is its 'Speedreader' option. This works like the 'reading mode' in other browsers, by removing images, design elements and other clutter from web pages to make their content easier to read. It also allows you to print online articles without wasting ink and paper on superfluous items. Unlike other reading modes, Speedreader modifies the page content before it loads, rather than after, which saves you data and provides faster load times. Brave 1.58, released in September, enhances the feature by letting you adjust the colour and font of pages to suit your visual needs. See our Workshop below to find out how.

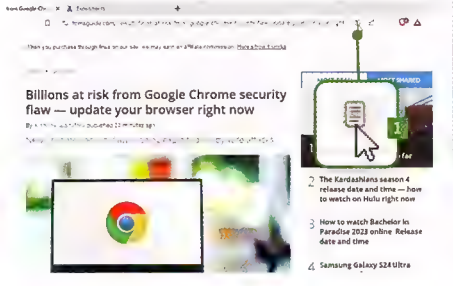


FIREFOX

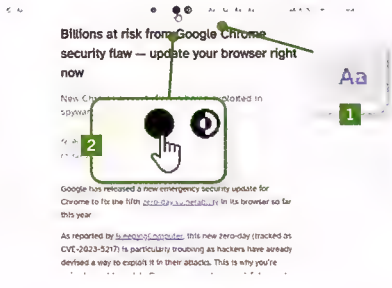
Import all your browsing data from Chrome

It's possible to import Chrome extensions into Firefox by activating a hidden

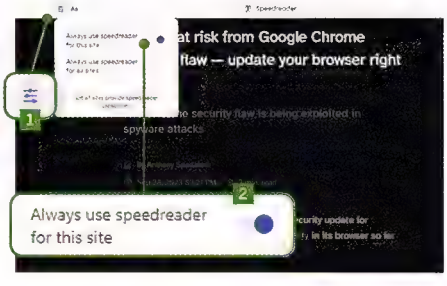
Workshop Fine-tune Brave's Speedreader mode



To use Brave's Speedreader mode, open an online article and click the Speedreader icon in the browser's address bar (this looks like a page of text 1). Brave will instantly strip the clutter from the web page to make it easier to read.



Click the new 'Appearance settings' button (which has an 'Aa' icon 1) to adjust how the page looks. You can switch between a light, sepia and dark theme 2; change the font to Serif, Monospace or Dyslexic; and increase the text size.



To always use Speedreader to view articles on the current site, click the 'Tune speeder' button (this looks like a set of sliders 1). Either select 'Always use speedreader for this site' 2 or opt to automatically apply the mode on all websites.

Best extension for... Blocking sponsored segments on YouTube

SPONSORBLOCK

Chromium | tinyurl.com/APC528sb
Firefox | tinyurl.com/APC528sbf

Ads aren't the only annoyance on YouTube – many videos are now preceded by sponsored messages that advertise products and services, or encourage you to subscribe to a channel. You can avoid most of these promotions by installing SponsorBlock, which automatically skips sponsored intros and outros, subscription reminders and "other annoying parts of YouTube videos", including the non-music parts of music videos. Just make sure 'Skipping is enabled' is switched on (see screenshot).

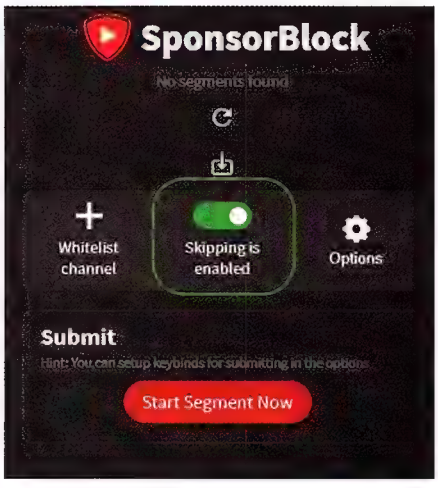
Users are encouraged to submit details of when sponsored messages start and end, which are then added to the extension's massive database of nearly 15 million 'skip segments'. The developer claims SponsorBlock has saved its users more than 1,760 years of their time.

IF YOU DON'T LIKE THAT, TRY...

SKIPSPONSOR

Chromium | tinyurl.com/APC528sbc

This extension uses AI to detect where sponsored segments appear in YouTube videos, then displays a button that lets you skip them.



experiment, but it's not straightforward. Version 119 of Mozilla's browser, released 24 October, officially introduces this option to make it much easier to transfer your favourite add-ons and other browsing data from Chrome.

Click Firefox's three-line menu button and choose Settings, followed by the General tab. Click the Import Data button in the Import Browser Data section and select Chrome in the dropdown menu – you can choose a specific profile. Click the plus button and either tick the 'Select all' box (see screenshot above) or select the data you want to import, including Bookmarks, 'Saved logins and passwords', Extensions and 'Form autofill data'.

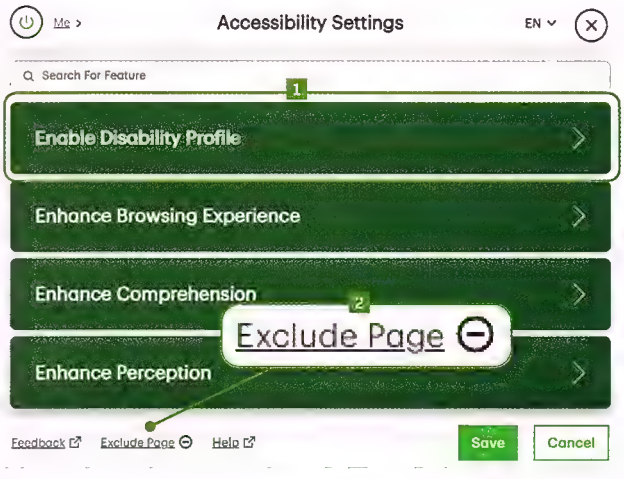
Click 'Import' and the selected data will be transferred to Firefox. It's a simple way to switch from Chrome if you want to ditch Google's browser for good.

OPERA

Play chess directly in your browser

Opera already has a browser for gamers, called Opera GX (**www.opera.com/gx**), and it's now launched one aimed at chess players. This chess-themed build of the browser is the result of a partnership between Opera and Chess.com, and can be downloaded from **tinyurl.com/APC528ch**.

It's essentially an upgrade to the current Opera One browser, which applies chess-piece wallpaper to your Speed Dial page and adds a **Chess.com** button to the left-hand sidebar. Click this button (see screenshot below) to open a Chess.com panel that lets you play chess online against "someone at your level" – choose between 'New to Chess', Beginner, Intermediate and Advanced.



You can either sign up for or into a Chess.com account, or play as a guest. Registering lets you challenge friends to a game, and compete in tournaments. Alternatively, click Play Computer to hone your skills by playing 'customisable training bots'.

The side panel also includes chess lessons, news and videos from Chess.com, though you need to subscribe to view some of this content. It's a fun feature for chess fans, and you can always stick with the standard Opera browser if it doesn't appeal.

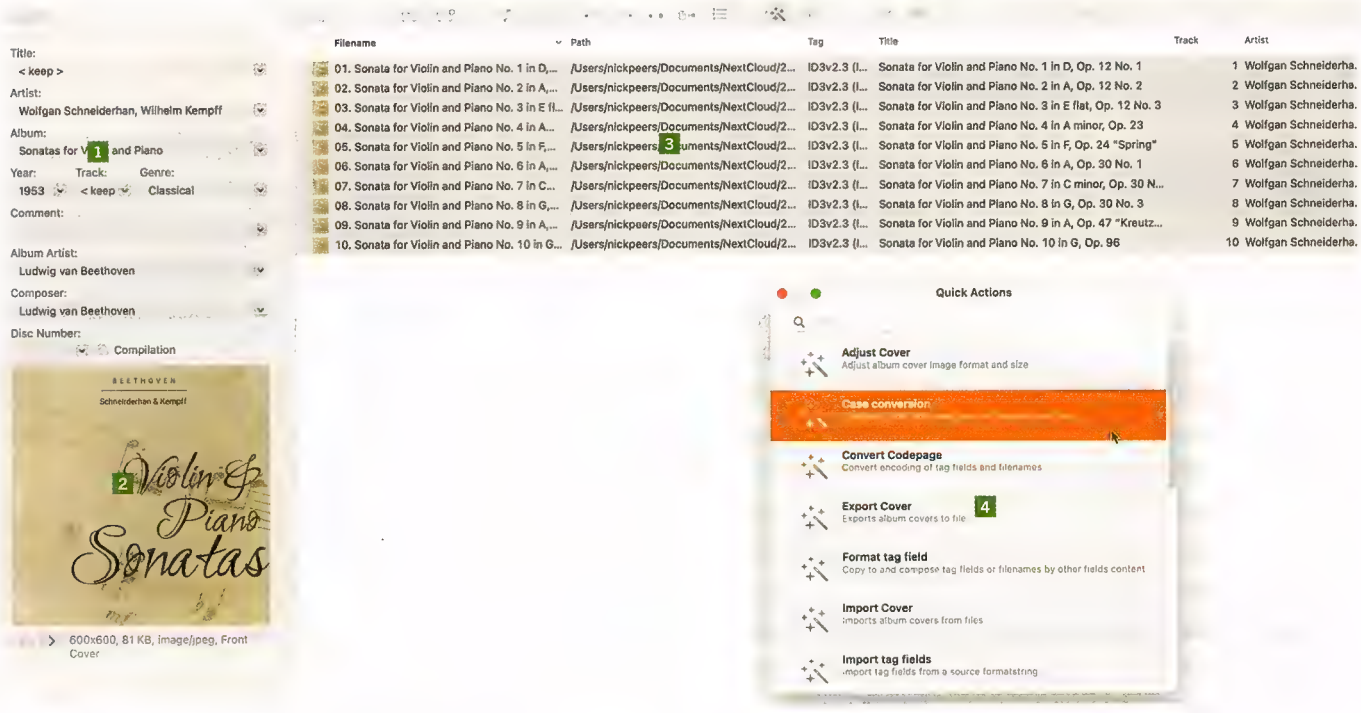
CHROMIUM

Adapt websites to your accessibility needs

Garish colours, hard-to-read text and autoplaying videos are common online annoyances, but for people with accessibility issues, they can make websites unusable and even hazardous to visit. A new extension called TD Accessibility Adapter (**tinyurl.com/APC528td**) allows users to personalise their web experience to meet their accessibility needs.

It lets you enable 'disability profiles' (1 in our screenshot above) for conditions including colour blindness, dyslexia, epilepsy and low vision, which include specific settings for adjusting different elements of websites. For example, the Colour Blindness profile can apply dark contrast or high saturation to pages, while the Epilepsy profile blocks animations and other autoplaying content, and Low Vision uses a larger 'readable' font.

You can also create a custom profile by choosing settings in sections such as Enhance Browsing Experience and Enhance Perception. To disable the extension on the current site, click Exclude Page in the bottom-left corner of the settings panel 2. ■


Title:
< keep >
Artist:
Wolfgan Schneiderhan, Wilhelm Kempff
Album:
Sonatas for V 1 and Piano
Year:
1953
Track:
< keep
Genre:
Classical
Comment:
Album Artist:
Ludwig van Beethoven
Composer:
Ludwig van Beethoven
Disc Number:
Compilation
BEETHOVEN
Schneiderhan & Kempff
2
Violin & Piano Sonatas
600x600, 81 KB, image/jpeg, Front Cover
Filename
Path
Tag
Title
Track
Artist
01. Sonata for Violin and Piano No. 1 in D,... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 1 in D, Op. 12 No. 1 1 Wolfgan Schneiderha.
02. Sonata for Violin and Piano No. 2 in A,... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 2 in A, Op. 12 No. 2 2 Wolfgan Schneiderha.
03. Sonata for Violin and Piano No. 3 in E fl... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 3 in E flat, Op. 12 No. 3 3 Wolfgan Schneiderha.
04. Sonata for Violin and Piano No. 4 in A... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 4 in A minor, Op. 23 4 Wolfgan Schneiderha.
05. Sonata for Violin and Piano No. 5 in F,... /Users/nickpeers 3 uments/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 5 in F, Op. 24 "Spring" 5 Wolfgan Schneiderha.
06. Sonata for Violin and Piano No. 6 in A,... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 6 in A, Op. 30 No. 1 6 Wolfgan Schneiderha.
07. Sonata for Violin and Piano No. 7 in C... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 7 in C minor, Op. 30 N... 7 Wolfgan Schneiderha.
08. Sonata for Violin and Piano No. 8 in G,... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 8 in G, Op. 30 No. 3 8 Wolfgan Schneiderha.
09. Sonata for Violin and Piano No. 9 in A,... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 9 in A, Op. 47 "Kreutz... 9 Wolfgan Schneiderha.
10. Sonata for Violin and Piano No. 10 in G... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 10 in G, Op. 96 10 Wolfgan Schneiderha.
Quick Actions
Adjust Cover
Adjust album cover image format and size
Case conversion
Convert Codepage
Convert encoding of tag fields and filenames
Export Cover 4
Exports album covers to file
Format tag field
Copy to and compose tag fields or filenames by other fields content
Import Cover
Imports album covers from files
Import tag fields
Import tag fields from a source formatstring

1 Bulk editing
Use the options here to quickly edit the relevant tag(s) across all currently selected tracks.

2 Switch artwork
Any embedded artwork appears here – click '<' and '>' to move between multiple images if relevant.

3 File list
A list of the files inside any folders you've opened or added via the File menu are shown here.

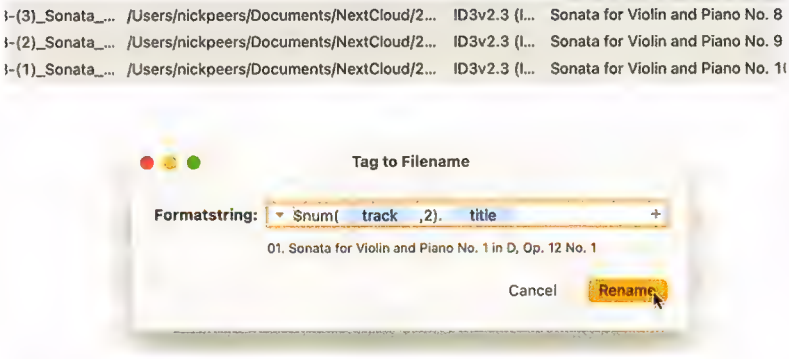
4 Quick Actions
Mp3tag includes several handy tools to automate certain tasks – click one to open a dialog box.

Tag your music to perfection

Make sure your music files display the correct information

IT WILL TAKE
15 minutes
YOU WILL LEARN
How to tag audio files automatically and manually
YOU'LL NEED
Mp3tag ($39.99), macOS 10.14 or later

If you've ever felt frustrated by the way your music collection is displayed in the Music app or by your media server, Mp3tag can help. The app makes it easy to track down the correct tags for files – from artist, album and track names to composers – along with suitable artwork, such as album covers or photos of the artist. This info is then embedded into your files in the form of 'metadata' that can be displayed in your music player, not just for show but to aid navigation.


)-(3)_Sonata_... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 8
)-(2)_Sonata_... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 9
)-(1)_Sonata_... /Users/nickpeers/Documents/NextCloud/2... ID3v2.3 (I... Sonata for Violin and Piano No. 1(
Tag to Filename
Formatstring: $num(track ,2). title
01. Sonata for Violin and Piano No. 1 in D, Op. 12 No. 1
Cancel
Rename

Mp3tag allows you to quickly rename files according to their tags, and you can generate tags from filenames too.

Tags and artwork can be manually added, or you can instruct Mp3tag to search major online databases like Discogs and MusicBrainz to find and insert the information and images you need in double-quick time. In this tutorial, we'll show you how to do both, plus reveal some of Mp3tag's time-saving tools to help speed up the tagging process.

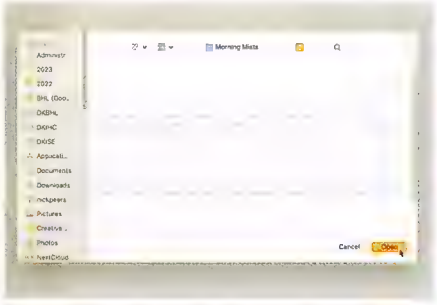
Getting started

You can download a free seven-day trial of Mp3tag from **mp3tag.app** – this is more generous than it sounds, because you can trial the program on seven non-consecutive days, so the clock doesn't start ticking from the moment you first launch it. Once the trial expires, you can purchase the full version for $39.99 (either from the mp3tag website or from the Mac App Store).

Once you've downloaded Mp3tag, double-click the Zip file to extract the program itself, then copy it into the Applications folder and launch it. Click Open followed by Continue Trial when prompted and you're ready to start using the program proper.

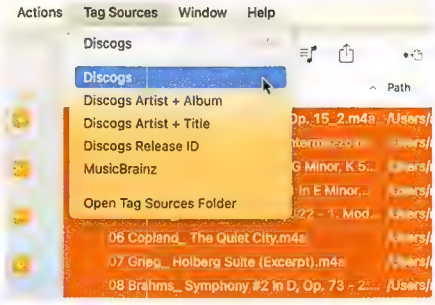
Nick Peers.

How to Tag your files with Mp3tag



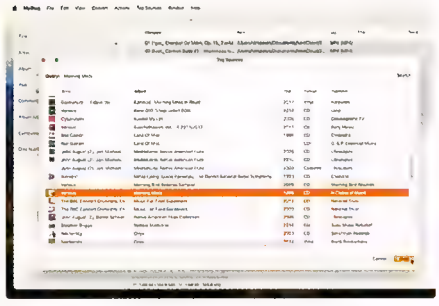
1 Add tracks

Open the File menu and choose Open. You can browse to a folder containing your music and click Open to add all the tracks inside, or simply select a single file and click Open. Choose File > Add to add more files/folders in this way.



2 Access search engines

The files will be listed in the main window – any metadata currently embedded into the file(s) will also be displayed. If you're looking to find a quick online match, go to Tag Sources > Discogs to open a search window.

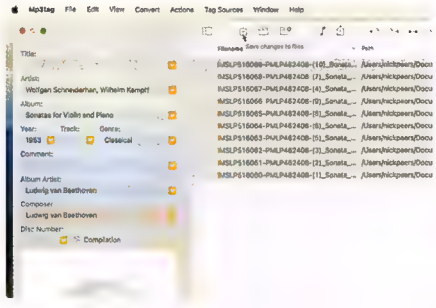


3 Find album match

If necessary, type the artist and/or album name into the Query box and click Search. A list of matching releases on Discogs will be shown. Use the information displayed (including format and catalogue number) to find a match.

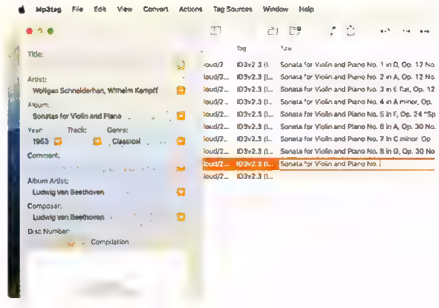
4 Review and tag

If the tags, album art and track names aren't a match, click Back to try another search result. Untick any information and artwork you don't want to import, change the order of tracks using drag and drop, then click Merge.



5 Manually input tags

You can tag files manually. Start by selecting all tracks from the same album and entering shared information (Album, Year, Genre, Album Artist) into the fields in the left-hand pane. Click the 'Save changes to files' button.

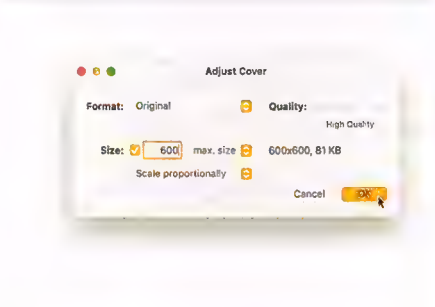


6 Input track-specific info

The quickest way to input track-specific tags like Title or Track is via the right-hand pane. Click inside the field of the first file, enter your tag and select Enter to save the tag to the file and move on to the next one.

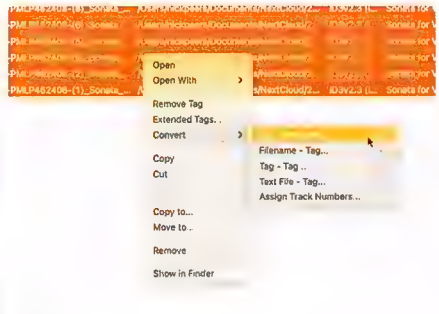
7 Add album artwork

To add artwork, select all your tracks again, then Ctrl-click the album thumbnail and choose Add. Select your artwork (PNG or JPG), which could be your own design (try postermywall.com) or a scan of the album cover.



8 Make artwork changes

Ctrl-click the image and choose Add to add more artwork or Adjust to resize and tweak the image. After adding another image, Ctrl-click it and use the Type submenu to set its description (such as back cover or artist picture).



9 Perform quick actions

Choose Actions > Quick Actions to bring up a menu offering some quick-fire tweaks, from converting case to replacing text, or Ctrl-click the selection to access a Convert submenu offering even more useful options. ■

Get your life organised!

Shashank Sharma knows more CLI tools than he does people, and is always looking for more. It's why he misses deadlines. But no more!

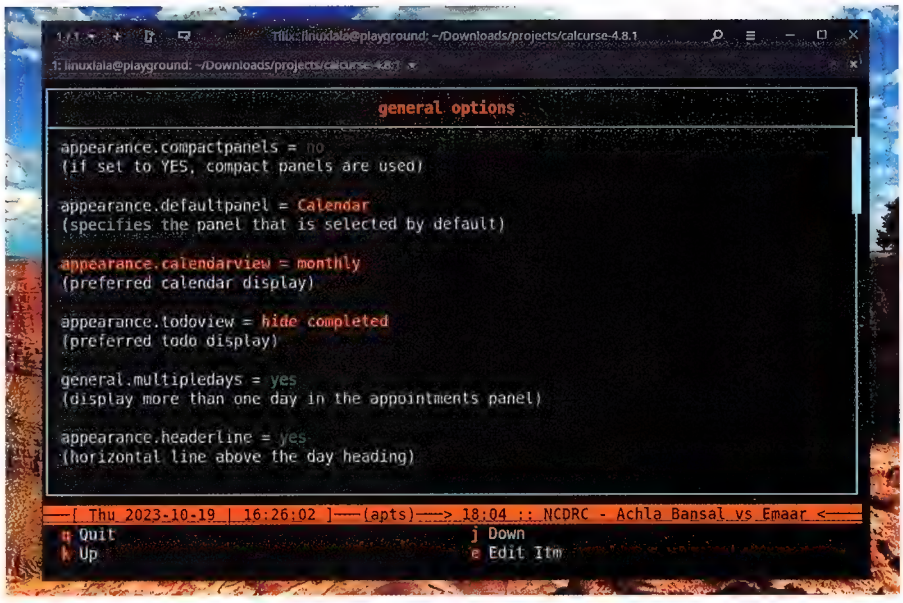
Contrary to what some Twitter (sorry, X) threads would have you believe, getting up at 5am and taking cold showers is not the only path to a productive day or week. In fact, simply making a note of all the tasks to be completed for a day or week can lead to being more productive – provided you do the work and complete the tasks.

Released under the BSD licence, Calcurse is a text-based organiser that features an Ncurses-driven interface. You can use the tool to keep track of important events such as birthdays and anniversaries, and also schedule appointments and everyday tasks. The default interface provides a list of all appointments for the week, as well as all your tasks in your to-do list. The notification system additionally informs you of upcoming deadlines to make sure you're always on top of your assignments.

Many modern desktop distros, such as Ubuntu, Fedora, Debian, Majaro, OpenSUSE and so on, feature Calcurse in their software repositories. However, not all of them offer the latest version. Refer to the project's GitHub page (**https://github.com/lfos/calcurse**) for a distro-specific list and the version on offer.

Because the project doesn't ship pre-compiled binaries itself, your only recourse is to compile it from source if your distro doesn't offer the latest version. While you can use the older version to test Calcurse, some features, such as the list of appointments for the week, were only introduced recently and so aren't available in the older versions. This is why you should consider compiling the latest version from source to fully appreciate the project's capabilities.

To make things easier still, all you really need are GCC and Ncurses, which are readily available in the software repositories. So, download the latest tarball from the project's website (https://calcurse.org/downloads) and extract the files with the `tar xvf calcurse-4.8.1.tar.gz` command.


general options
appearance.compactpanels = no
(if set to YES, compact panels are used)
appearance.defaultpanel = Calendar
(specifies the panel that is selected by default)
appearance.calendarview = monthly
(preferred calendar display)
appearance.todoview = hide completed
(preferred todo display)
general.multipledays = yes
(display more than one day in the appointments panel)
appearance.headerline = yes
(horizontal line above the day heading)
[Thu 2023-10-19 | 16:26:02]—(apts)—> 18:04 :: NCDRC - Achla Bansal vs Emaar <—
q Quit
k Up
j Down
e Edit Itm

Many configurable parameters – such as the panel that is selected by default when you start Calcurse, autosave and so on – can be tweaked from under General Options.

You can now install Calcurse following the instructions in the INSTALL file. The process involves running the `./configure`, `make` and `sudo make install` commands to compile and install the tool from source.

Mastering the interface

The default interface comprises three panels. The sidebar on the right holds two panels: a Calendar at the top and the Todo panel below it. You can press the Tab key to switch between the panels.

After selecting the Calendar panel, use the arrow keys to select a date – all the defined appointments for that day are displayed in the Appointments panel, along with their start and end times. All-day events are displayed at the top of the Appointments panel, and don't have a corresponding start or end time.

The Todo panel similarly holds a list of all the tasks you wish to accomplish, along with the defined priority.

Below these is the notification area. It displays the current date and time, and any upcoming appointment.

At the bottom is the status bar, which lists possible actions, such as Help, Quit, Save, Reload and so on.

Calcurse uses colours and boundaries so that selected panels and other useful elements stand out. For instance, the Calendar panel uses different colours to identify dates for which you have defined an appointment. The boundaries of the panel also change to help you determine which panel is selected.

You can tweak Calcurse to a large extent from within its graphical interface by pressing `C`. The configuration options are split into six categories: General, Layout, Sidebar, Colour, Notify and Keys.

The tool offers the choice of eight layouts, which govern the placement of the panels. You can also choose a different colour scheme or tweak the display of information in the main notification bar.

> "Many modern desktop distros, such as Ubuntu, Fedora, Debian, Majaro, OpenSUSE and so on, feature Calcurse in their software repositories. However, not all of them offer the latest version."

It's a date!

To add a new appointment for the current date, press a from the Appointments or Calendar pane or Ctrl+a from anywhere in the Calcurse interface. You're asked to specify the start and end times for the appointment, and a description. After filling in these details, the new entry is listed in the Appointment panel. You can leave the start/end time blank for an all-day event. Repeat the process to add appointments for the same date, or select a different date to add more appointments. You can even create recurring appointments and Calcurse enables you to define the frequency, whether it's daily, weekly, monthly or yearly. The latter two options are useful for setting up reminders to pay utility bills or insurance premiums.

To create a recurring appointment, you must first add the appointment. Now select an appointment from the list, using the arrow keys. Press r to create a recurring appointment, and follow the instructions in the status bar at the bottom of the interface. You can similarly edit an appointment by first selecting it, then pressing e. The tool then asks you to choose whether you wish to change the start or the end time for the selected appointment, or its description:

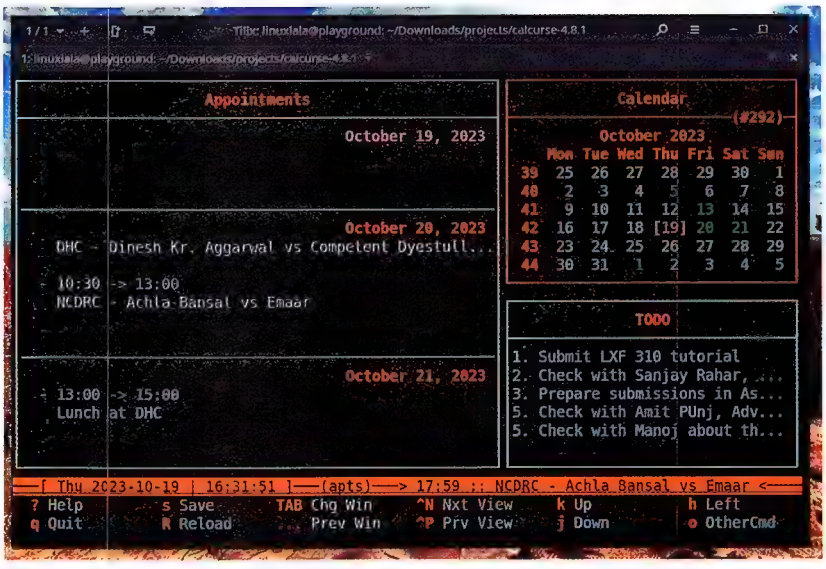
```
Edit: (1) Start time, (2) End time, (3)
Description, (4) Move?
[1/2/3/4]
```

Remember that the start time can't be greater than the end time. That is, you can't have an appointment that starts at 17.30 but ends at 16.00. So, if you wish to delay your hour-long gym schedule from 18.00 to 19.30, and also reduce it to only 45 minutes, you must first change the end time, before attempting to change its start time. But if you want to retain the duration of the appointment and only change the start time, opt for the Move option. This prompts you to enter the new start time, and the tool automatically updates the end time, retaining the original length of the appointment.

The edit option only lets you edit the Description for all-day events. So, once you've created an all-day event, you can't then add a start/end time for that event.

You can similarly add a new to-do entry by pressing Ctrl+t from anywhere in the Calcurse interface or pressing a after selecting the Todo panel. When adding a new to-do entry, Calcurse prompts you to specify a priority for the new task:

```
Enter the TODO priority [0 (none), 1
(highest) - 9 (lowest)]:
```


Appointments
October 19, 2023
October 20, 2023
DHC - Dinesh Kr. Aggarwal vs Competent Dyestull...
10:30 -> 13:00
NCDRC - Achla Bansal vs Emaar
October 21, 2023
13:00 -> 15:00
Lunch at DHC
Calendar
(#292)
October 2023
Mon Tue Wed Thu Fri Sat Sun
39 25 26 27 28 29 30 1
40 2 3 4 5 6 7 8
41 9 10 11 12 13 14 15
42 16 17 18 [19] 20 21 22
43 23 24 25 26 27 28 29
44 30 31 1 2 3 4 5
TODO
1. Submit LXF 310 tutorial
2. Check with Sanjay Rahar, ...
3. Prepare submissions in As...
5. Check with Amit PUnj, Adv...
5. Check with Manoj about th...
Thu 2023-10-19 | 16:31:51 (apts) 17:59 :: NCDRC - Achla Bansal vs Emaar
? Help
q Quit
s Save
R Reload
TAB Chg Win
Prev Win
^N Nxt View
^P Prv View
k Up
j Down
h Left
o OtherCmd

You can access command-specific help by running the :help <key> or :help <command> commands, such as :help a for help with appointments.

FETCHING INFORMATION

If you don't want to launch the interface to access the appointments or to-do list, the alternative is to run the tool in what the project refers to as the non-interactive mode. This is done by invoking Calcurse with any possible command option, such as -a, -d, -n and so on.

For instance, the calcurse -a command displays the appointments for the current day, and then drops you back to the shell. The command calcurse -d <date|num> displays the appointments for the specified date, or all the appointments for the next number of days:

```
$ calcurse -d 15
10/20/23:
 * DHC - Dinesh Kr. Aggarwal vs Competent Dyestuff & Ors - CS (OS) 252/2021
 - 10:30 -> 13:00
   NCDRC - Achla Bansal vs Emaar
11/01/23:
 * NCDRC - Sujit Singh & Ors. vs Supertech Ltd - CC/1915/2016
```

For each of these command options, Calcurse traverses through its database and prints on the screen the information sought by the user. Refer to the man page for a list of all command options and what each does.

You can similarly run the calcurse -t <value> command to view a list of all tasks in the Todo list with the specified priority value.

You can even change the priority for a selected to-do entry by pressing the + and – keys. For each appointment or to-do entry, you can also create an additional note to provide more information. So, if you schedule a lunch appointment every day at 15.30, but next Thursday the lunch is with the boss and you wish to wear a tie, you can add a little note to this appointment. Select the appointment in the list, and then press Ctrl+n to add a new note. This opens the default text editor and you can fill in the pertinent details, save the file, and quit.

After being dropped back to the Calcurse interface, you'll find a > symbol next to the appointment in the Appointments panel. This denotes that the entry has a note attached to it. You must press the > key on the keyboard to read this note. As the notes are specific to each appointment or to-do entry, you must first select the respective entry to read the note attached to it. Remember to press s to save the changes after adding or editing an appointment or to-do entry.

While we've only discussed the very basic usage of the tool, Calcurse is capable of much more. It stores all its data in plain text files, and lets you export specified user data to the ICAL and PCAL formats. It also supports a large number of filtering options to help you easily narrow down the information you're looking for when running the tool in non-interactive mode. ■

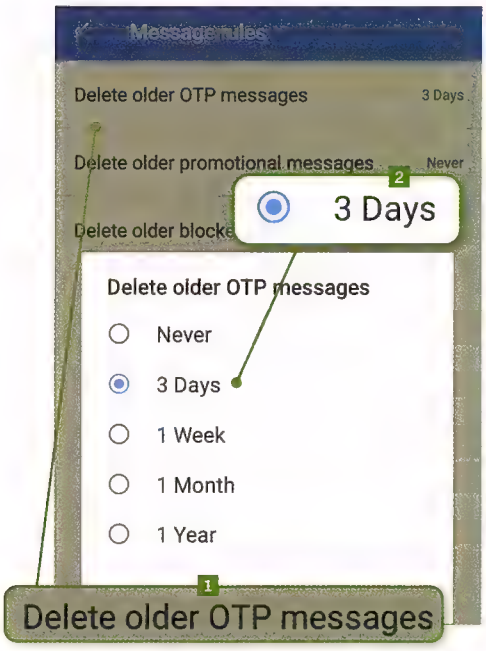
Phone & tablet tips

Brilliant things to do on your device.

ANDROID

Delete 2FA verification codes automatically

One of the main downsides to using two-factor authentication (2FA) for your online accounts is that your text-messaging app becomes cluttered with verification codes. Also called one-time passwords or passcodes (OTPs), these are sent to your phone by the website or app you're trying to sign into, and expire once you enter them or after a set time.



Google's Messages app for Android (**tinyurl.com/APC5282FA**) lets you prevent your SMS inbox from getting clogged up with expired OTPs by deleting these messages automatically after 24 hours. Tap your profile picture in the top-right corner of the Messages app and choose 'Messages settings'. Select 'Message organisation' and switch on 'Auto-delete OTPs after 24 hrs'.

If you don't see those options, the auto-delete feature may not be available yet for your version of Android. Until it arrives, you can get a similar option by installing the Microsoft app SMS Organizer (**tinyurl.com/APC528sms**). Set this as your default SMS app when prompted, let it import your text messages, then press Get Started.

When SMS Organizer opens, tap the three-dot menu in top right and choose 'Message rules'. Select 'Delete older OTP messages' (1 in our screenshot below left) and choose '3 Days' 2 or '1 Week'.

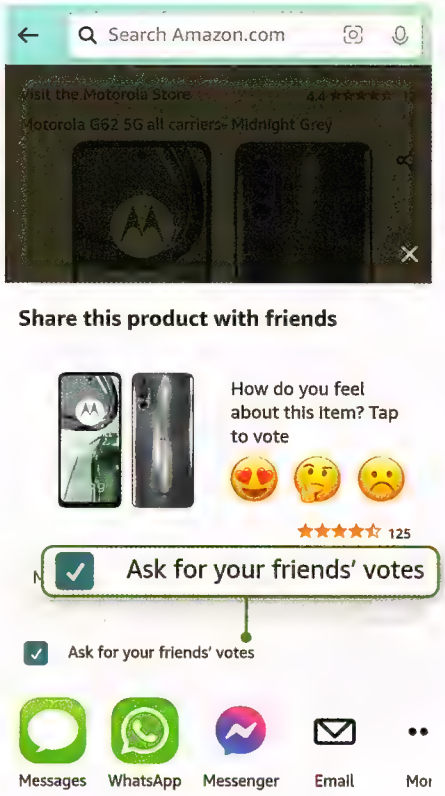
ANDROID & iOS

Consult friends and family about Amazon purchases

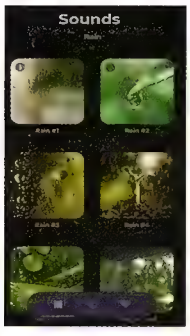
As we enter the busiest shopping period of the year, Amazon has introduced a new feature that lets you ask your friends and family for advice about your purchases.

It's called Consult-a-Friend and lessens the risk of buying someone an unwanted or unsuitable present. To use Consult-a-Friend in the Amazon Shopping app for Android (**tinyurl.com/APC528am**) and iOS (**tinyurl.com/APC528ami**), tap the Share button on a product page and tick the box 'Ask for your friends' votes' (see screenshot above right). Choose your preferred messaging or email app, and (optionally) turn on notifications for when friends vote on items. Select the people whose feedback you want, then send them a message containing a link to the product.

They can react with an emoji, such as heart eyes, thinking face or sad face, and



Best new apps — What you should install this month



SOOTHING SOUNDS

Free*

Android tinyurl.com/APC528ss

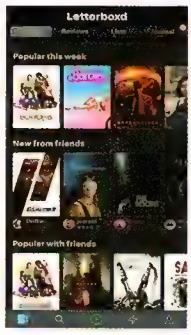
This updated app helps you drift off to sleep or relax after a hard day by playing calming sounds. Its expanded selection includes rain, windchimes, lapping waves, white noise and – somewhat bizarrely – hair salon. You can create mixes of sounds, set a switch-off timer and pay $1.59 to remove the annoying ads.

VIVALDI FOR iOS

Free

iOS tinyurl.com/APC528viv

Vivaldi has updated its new iOS app with the ability to pin important tabs (see screenshot) so they aren't closed when you exit the browser. You can also now assign nicknames to search engines to make them easier to switch between – just type the nickname into the address bar then your search query.



LETTERBOXD

Free*

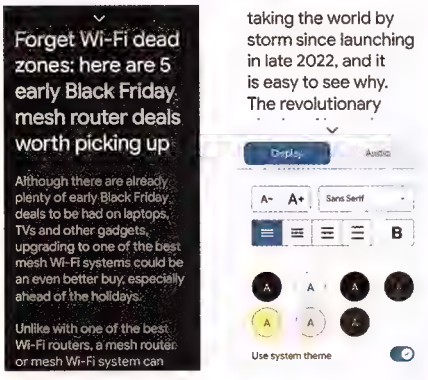
Android tinyurl.com/APC528let

iOS tinyurl.com/APC528leti

This popular app for movie lovers, which lets you discover, rate and create watchlists of films, has been updated to support two-factor authentication (though not passkeys). Letterboxd has also added the option to sort films by 'Your Interests' – based on the titles you've previously 'liked'.

*Contains in-app purchases

Best apps for... Making text easier to read


Forget Wi-Fi dead zones: here are 5 early Black Friday mesh router deals worth picking up
Although there are already plenty of early Black Friday deals to be had on laptops, TVs and other gadgets, upgrading to one of the best mesh Wi-Fi systems could be an even better buy, especially ahead of the holidays.
Unlike with one of the best Wi-Fi routers, a mesh router or mesh Wi-Fi system can
taking the world by storm since launching in late 2022, and it is easy to see why. The revolutionary
Display
Audio
Sans Serif
Use system theme

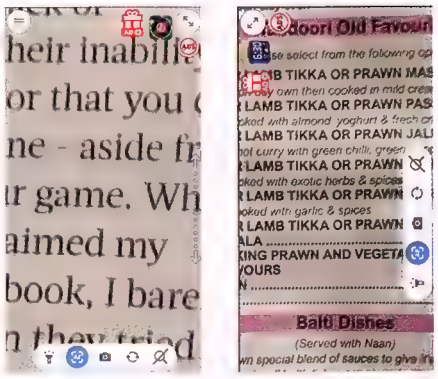
READING MODE

Free

Android tinyurl.com/APC528read

Google's 'Reading mode' app helps people with poor vision and dyslexia read online content more easily. Tap its floating shortcut when viewing an article in your mobile browser or another app to remove everything but the text and enlarge the words. Adjust the size and font as required.

Best For: Making web content easier to read



MAGNIFYING GLASS + FLASHLIGHT

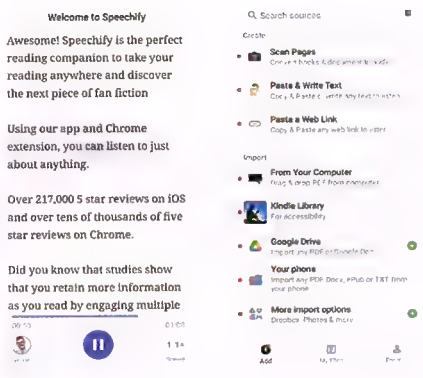
Free*

Android tinyurl.com/APC528mag

iOS tinyurl.com/APC528magi

This app uses the camera on your phone or tablet to magnify small text on objects in front of you, such as books, restaurant menus and medication instructions. You can easily adjust its zoom level and brightness, take photos of what you're reading and activate your device's torch when using the app in the dark.

Best For: Magnifying text on objects


Welcome to Speechify
Awesome! Speechify is the perfect reading companion to take your reading anywhere and discover the next piece of fan fiction
Using our app and Chrome extension, you can listen to just about anything.
Over 217,000 5 star reviews on iOS and over tens of thousands of five star reviews on Chrome.
Did you know that studies show that you retain more information as you read by engaging multiple
Scan Pages
Paste & Write Text
Paste a Web Link
From Your Computer
Kindle Library
Google Drive
Your phone
More import options

SPEECHIFY

Free*

Android tinyurl.com/APC528sp

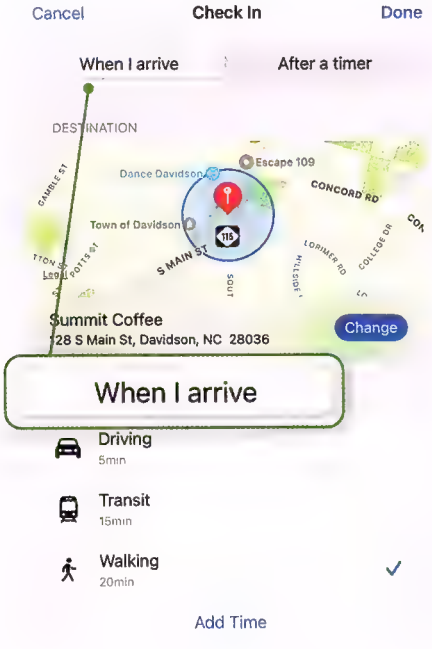
iOS tinyurl.com/APC528spi

Speechify saves you having to focus on text, by reading aloud the content of PDFs, web pages, ebooks and more. Choose from dozens of AI voices, select your listening speed, then add a file. Press 'play' to hear the content, with the text highlighted as it's read. Upgrade to the Premium version for unlimited use.

Best For: Listening to text read aloud

tell you their thoughts on the item. You can then view their collective sentiment in the Amazon Shopping app, to help you decide whether to proceed with the purchase.

Consult-a-Friend is being rolled out gradually, but everyone should have it before Christmas.



iOS

Let people know when you've arrived

Of all the features introduced in iOS 17, arguably the most useful is the new Check In option in the Messages app. This allows you to quickly inform your friends and family when you arrive safely at a destination, to give them peace of mind.

Check In lets you share important information while travelling, such as your current location, network-signal strength and iPhone battery level, and your means of transport. It also monitors your journey and notifies your loved ones if you haven't reached your destination when expected.

To use Check In, launch the Messages app and open a chat with the person you want to share your location with (you both need to have Location Services enabled). Tap the plus icon next to the message box and select Check In. The first time you use the feature, iOS 17 will ask you to decide whether to give Limited or Full data-sharing access.

Tap 'Edit' to specify your Check In details. On the 'When I arrive' tab (see screenshot above), select your destination and estimated travel time, based on your mode of transport. Tap the 'After a timer' tab to set up an alert to confirm you've arrived. If you don't respond to the confirmation prompt within 15 minutes, the other person will be notified.

Press 'Done' then Send to confirm and share your Check In. You can cancel it and add extra time if you're running late.

iOS

Move Chrome's address bar to the bottom

Google has updated its Chrome app for iOS (**tinyurl.com/APC528chr**) with the option to relocate the address bar from the top of the browser to the bottom. Many consider this more convenient for one-handed use, especially on 'tall' phones where it's trickier to reach the top of the screen.

Safari already gives you this option, so it's possible Google is using it to lure users away from Apple's browser, on iPhones at least – it's not available in the Chrome app for iPad.

To move Chrome's address bar to the bottom of the browser, simply long-press it and choose 'Move Address Bar to Bottom'. If you can't see the option, open the Settings menu in Chrome, tap 'Address bar' and select Bottom as your preferred position (see screenshot right). You can move it back to the top if you change your mind.

Curiously, Google hasn't added the option to Chrome for Android, though other browsers – including Firefox – have their address bars at the bottom. ■

Create a Pi Pico USB camera trigger

Les Pounder's drawers are full of old tech. No, he's not smuggling technology, but he is reusing it in this project!

YOU'LL NEED
- Pi Pico
- PIR sensor (obstacle sensor)
- Breadboard
- Jumper wires to connect Pico to PIR
- Android device
- Pico-to-Android cable
- Code: **tinyurl.com/APC528USB**

We've all got a spare smartphone lurking in a drawer. Some of these devices will gather dust and then get recycled. But what if we could reuse them?

In this project, we're reusing an old phone with a Raspberry Pi Pico-powered camera trigger. Using a PIR (passive infrared) sensor, we will detect movement and use that to trigger the camera to take a photo. The Pi Pico is running CircuitPython and is acting as an emulated USB keyboard. Trigger the sensor, and the 'keyboard' presses Enter and takes a photo.

Pick a Pico

There's a plethora of Pico-compatible boards on the market. There are boards from Raspberry Pi, Pimoroni, Adafruit, Waveshare, Sparkfun and a few clones from Aliexpress. We chose Seeed's XIAO RP2040 board. It is much smaller than a Raspberry Pi Pico and it has fewer GPIO pins, but the most important thing is that it has USB C. Our Android device also has USB C, and that means we only need a USB C cable to connect the pair. The Android device will power the XIAO RP2040, and present itself as a USB keyboard. If you only have a Raspberry Pi Pico, you need to use a series of adapters to convert USB A to USB C.

With an old phone, a low-cost Raspberry Pi Pico and a sensor, we can build a quick camera trap for nature cameras, parties and more.

Building the project

The PIR sensor has only three connections: VCC, GND and Data OUT. VCC connects to the 5V (VBUS) pin on the Pico. GND connects to any GND pin on the Pico. Data/OUT connects to GP7/D7 on the Pico (10 pins down on the left of a Pico). That's it. Your PIR sensor may be a little sensitive, so you can either tweak the potentiometer, hidden around the back, or use a paper cup or funnel to restrict its vision. See the schematic in the download.

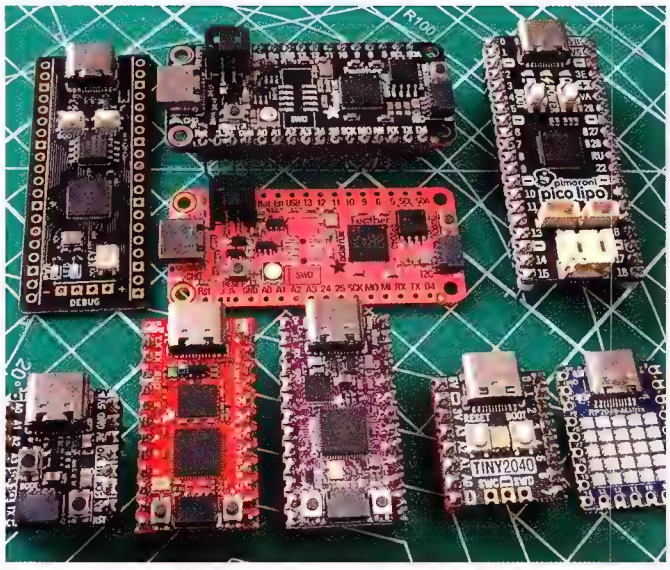
Connect the Raspberry Pi Pico to your computer while holding the BOOTSEL button. This forces the Pico into bootloader mode and a new drive, RPI-RP2, appears in the file manager. Open a browser to **https://circuitpython.org/board/raspberry_pi_pico/** for the Raspberry Pi Pico or **https://circuitpython.org/board/raspberry_pi_pico_w/** for the Pico W. Download the latest stable version of CircuitPython for your Pico. From the Downloads folder, copy the CircuitPython file (a UF2 firmware image) to the RPI-RP2 drive. After a few moments, the drive disappears and is replaced with CIRCUITPY. This is where we will write the code for the project.

The next step is to copy a series of files into the /lib directory of the CIRCUITPY drive. Open a browser to **https://circuitpython.org/libraries** and download the library bundle for the version of CircuitPython that you have downloaded. We downloaded version 8.26, so downloaded the bundle for CircuitPython 8. Extract the downloaded archive and then navigate to that directory. From that directory, we need to copy adafruit_hid to the lib directory of CIRCUITPY. This library will be used to emulate a USB keyboard.

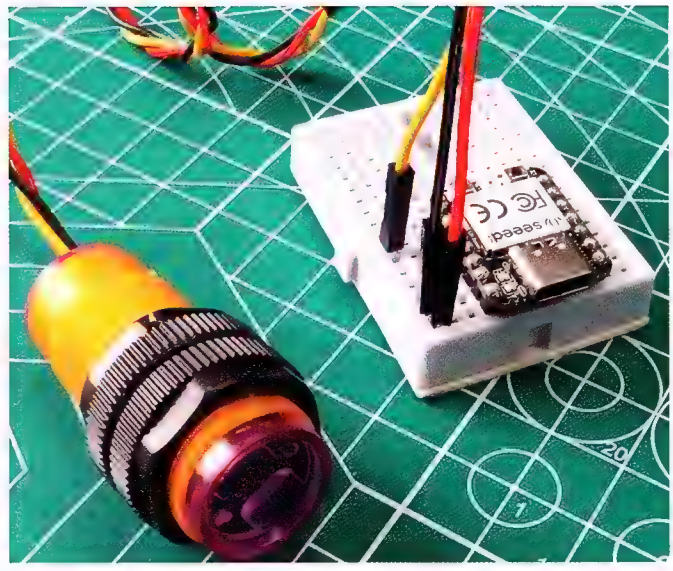
Now open your favourite text editor – we chose Thonny because it can directly work with CircuitPython devices. Create a new file and start the project code by importing a series of modules. The first few modules are time, board and usb_hid. Time is used to control the pace of the project code, board enables us to use the GPIO, while usb_hid creates a USB human interface device (keyboard, mouse and so on) using the Raspberry Pi Pico.

```
import time
import board
import usb_hid
```

Next we import specific parts of a series of modules for creating USB HID keyboards, sending keycode (specific keys) and digital IO used to



This is just a small selection of all the RP2040-based boards we own. They all feature USB C, necessary for connecting to our Android device.



The basic circuit is just three wires to connect the sensor to the Pico.

interface the sensor to the code:

```
from adafruit_hid.keyboard import Keyboard
from adafruit_hid.keycode import Keycode
from digitalio import DigitalInOut, Direction, Pull
```

We create two objects – one represents the emulated keyboard, the other represents the sensor:

```
kbd = Keyboard(usb_hid.devices)
sensor = DigitalInOut(board.D7)
```

We need to set the sensor GPIO pin as an input, and then pull the GPIO pin high (up). The GPIO pin has an internal resistor that we can pull up to 3V or down to 0V (GND). We want the GPIO pin to be high by default.

```
sensor.direction = Direction.INPUT
sensor.pull = Pull.UP
```

Now we move into the main body of code, and use a while True loop to constantly run the code within it.

```
while True:
```

Inside the loop, code is indented to show it belongs inside the loop. We first print the current sensor value. This isn't strictly necessary, as it never appears on the phone screen, but it is useful for debugging.

```
    print(sensor.value)
```

The next step in the loop is to use a conditional test. It checks if the sensor has been triggered. By default the sensor reports True, but if the beam is broken, it reports False. If it sees a False, the code within the conditional statement is run.

```
    if sensor.value == False:
```

The code runs a key press, using a keycode. Our emulated keyboard presses the ENTER key, pauses for 0.1 seconds, prints a message to the Python Shell (again for debug) and then it releases the keypress.

```
        kbd.send(Keycode.ENTER)
        time.sleep(0.1)
        print("Enter pressed, photo taken")
        kbd.release_all()
```

But what if the user hasn't triggered the sensor? Here is where the else condition is activated. This simply uses pass to let the loop complete, after a one-second pause.

```
    else:
        pass
    time.sleep(1)
```

Save the code to the Raspberry Pi Pico CIRCUITPY drive as code.py. CircuitPython automatically runs the code when the board is powered up.

> "In this project, we're reusing an old phone with a Raspberry Pi Pico-powered camera trigger."

Click on Run to test the code. Click on the Python Shell so that focus is on the Shell. Wave your hand in front of the sensor and you should see False, Enter pressed, photo taken and a new line appear. This proves that your Raspberry Pi Pico is acting as an emulated keyboard.

Remove the Raspberry Pi Pico and connect it to your Android phone or tablet. We have a phone with USB C, so we chose a USB C-based Raspberry Pi Pico alternative. Open the camera app on your device. Now wave your hand in front of the sensor and the camera will start taking pics. ■

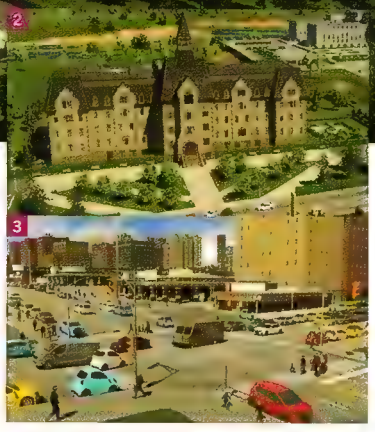
CIRCUITPYTHON USB HID

CircuitPython is amazing for creating USB HID devices. Adafruit's language is a fork of MicroPython and it uses a library of prewritten modules to make it really easy to use a board in a project.

Not only does Adafruit have great module libraries, but it also has great documentation. We referred to the documentation to remind ourselves how to use keycodes. Take a look for yourself at **https://docs.circuitpython.org/projects/hid/en/latest/index.html**.

More advanced users will love Consumer Control Codes. With these, we can emulate multimedia keyboards with audio controls, brightness and special keys to launch applications. With USB HID, we can create our own keyboards, shortcuts, mouse and even emulate basic joypad or joystick inputs.

If you fancy building your own USB HID device using CircuitPython, we recommend Adafruit's KB2040 board, a custom RP2040-powered board designed just for making user input devices. It is just a little bit larger than the XIAO RP2040, has a few more GPIO pins, Stemma QT for sensors, and a USB C port useful for modern phones and laptops.



PRICE $69.95 **PLATFORM** PC, PS5, XBS/X **WEB** tinyurl.com/APC528cs2

Cities: Skylines II

A lot bigger than the original, but not quite better.

***Cities: Skylines II* is much bigger than the original, but unfortunately it's not better – at least not yet. As in the first game, you begin with a small square of land on a giant slice of map. You start laying down roads, zoning for residential, commercial, and industrial areas, and watch as little bitty homes and businesses begin to spring up. Then the delicate dance begins as you try to balance budgets and costs while expanding from a small town to a booming city to a mega-metropolis filled with towering skyscrapers, airports and harbours, and thousands of simulated citizens.**

There are some big early game improvements over the original *Skylines*, like the ability to import electricity from another unseen city by simply attaching your power lines to theirs. Not having to immediately build a huge polluting power plant not only saves money but precious space on your starting map square. An even better perk: When I later had both the cash and the room to build a couple big stinky power plants of my own, I was able to export my surplus electricity back down those same power lines and make some extra money.

It's instantly easy to see how much work went into creating better road tools for the sequel. Drawing roads and snapping them together is smooth and easy, as is upgrading those roads later with new features – lines of trees, grassy strips, and tram lines for public transportation can be placed directly onto existing roads with zero fuss.

Progression is handled nicely, too. Instead of simply being based on population milestones, you earn XP by building stuff, attracting new residents, and increasing the happiness of your citizens. Each XP milestone automatically unlocks new city features but also grants you a handful of development points you can spend on more unlocks. If you want to upgrade your power station to solar early on, you can spend points on electrical options, and if you want to build a huge observation tower, start dumping points into the parks department. The system is sensible and gives you control over what you'll be able to add to your city and when, reminiscent of a strategy game tech tree.

Cities: Skylines II has performance issues, though. Some tinkering with default settings improved my fps but at the cost of lowering the level of detail or disabling systems like depth of field. I experienced a lot of random FPS dips, slowdowns and hitches, and sometimes complete freezes that lasted a few seconds, along with visual issues like irritating shadow-flickering on certain buildings. As you'd guess, the bigger the city gets the more severe performance issues become, and while I expect plenty of optimisation of *Cities: Skylines II* to occur post-launch, right now, it's a bit rough.

1 Soon your tiny town becomes a big city.
2 Some buildings can cost millions to construct and maintain.
3 Traffic is an issue, but not nearly as much as it was in the original.

It doesn't really feel like a proper city until you have an airport.

VERDICT

The city builder sequel is packed with big improvements but a fair share of disappointments.

Christopher Livingston

PRICE $59.95 **PLATFORM** PC, PS4/5, XBS/X **WEB** tinyurl.com/APC528pd3

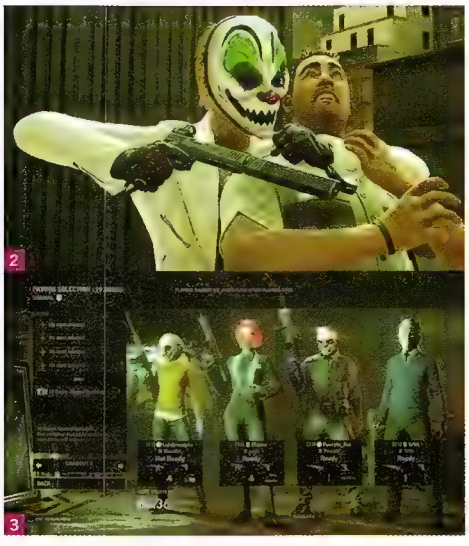
Payday 3

Surviving the grind.

Compared to *Payday 2*, *Payday 3* dials everything back down to zero and could easily be mistaken for a reboot. Most of the original crew return from the previous games, but seem to have forgotten where *Payday 2* left off. *Payday 3*'s eight-mission storyline is so serious and straightforward that it was hard to believe I was playing the sequel to a game where a character swaps bodies with the President of the United States after breaking into an ancient bunker beneath the White House.

While playing *Payday 3*, I was retroactively sold on Payday 2 and disappointed by the sequel's reluctance to embrace its predecessor's absurdity. Despite having loads of weaponry and skills to handle waves of enemies, stealth runs in *Payday 3* are the best way to unlock the most exciting toys – even the ones that have nothing to do with stealth in the first place. Its list of challenges reward you with Infamy levels that unlock more weapons and gear to buy, but the stealth-related ones are often the most valuable. They're so rewarding that it undercuts the depth available in its firefights.

Once you've broken stealth, enemies pour in from every angle and you often don't know where your escape will be. It's here where *Payday 3* shines, forcing you to bring weapons to help manage – and not necessarily kill – each wave of enemies. Shotguns stagger multiple cops in cramped spaces, and I found having a marksman rifle to quickly pick off the most dangerous foes in a crowd particularly useful on the bigger maps. Missions require your team to cover each other as you race to secure bags of cash before you're completely overwhelmed.



Payday 3's best moments are when mistakes happen and, instead of giving you a game over, the game shifts into a different mode. It emulates the ramping tension of a heist movie and lets everyone play a role no matter what gear they bring to the mission. It's a blast to improvise your solutions on the fly.

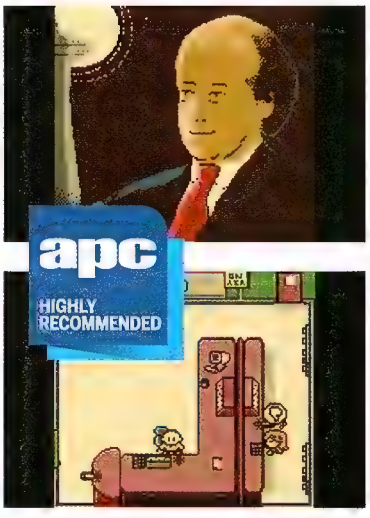
1 Every level offers multiple ways to secure the objective.
2 You can use hostages as shields to keep cops from shooting at you.
3 You can customise loadouts for each mission.

VERDICT

★★★☆☆

Starbreeze Studios' *Payday 3* is a slick co-op shooter mired by a somewhat limiting progression system.

Tyler Colp



PRICE Free **PLATFORM** PC, browser
WEB tinyurl.com/APC528ff

FRASIER FANTASY

TOSSED SALADS AND RANDOM BATTLES.

Frasier is back. Yes, in a new TV series, but also in this fan game, which takes the neurotic radio shrink and drops him into a turn-based JRPG. It does sort of make sense – but is it actually worth playing, beyond the gag of its mere existence? To cut to the chase: yes. This is one of the best fan games I've played.

The setup is that *Frasier* is hosting one of his dinner parties, but there's a to-do list before he is finally ready. He needs his crotchety dad Martin, and his dog Eddie, out of his apartment; he needs his grape scissors back from his brother Niles; and he has to host his radio show down at the station. Cue turn-based battles, simple stealth and sparkling dialogue, in an adventure that hits all the classic *Frasier* beats.

It's a comedy of sibling rivalry, pretension and dinner-based farces work as a JRPG. No small feat, but do you need to be a *Frasier* fan to enjoy it? I think you probably do, yes.

VERDICT

★★★★½

A polished, hilarious fan game that makes great use of its source material. But best for *Frasier* fans, obviously.

Tom Sykes

PRICE Free **PLATFORM** PC, Mac, Linux, browser **WEB** tinyurl.com/APC528mr

MR PLATFORMER

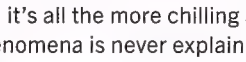
A SIDESCROLLER THAT REALLY GOES PLACES.

Mr Platformer takes a very strange turn, but for most of its runtime it's just a good platform game, with a simplicity that's refreshing in an era of Metroidvanias and platforming roguelikes. With its low-res art and short, challenging stages, it plays like Mario if it was demade for the ZX Spectrum.

Each stage is themed around a platforming facet, be it *Pitfall!*-style vine swinging, Mario-esque swimming, or hunting keys in an underground environment, but every time you reach the final stage, there's a curious horror vibe – and then you're thrown back to the start of the world map. Things are different now, however. Completed stages have been wiped from the map, replaced with others. And when you beat a stage, a timer counts down – but to what?

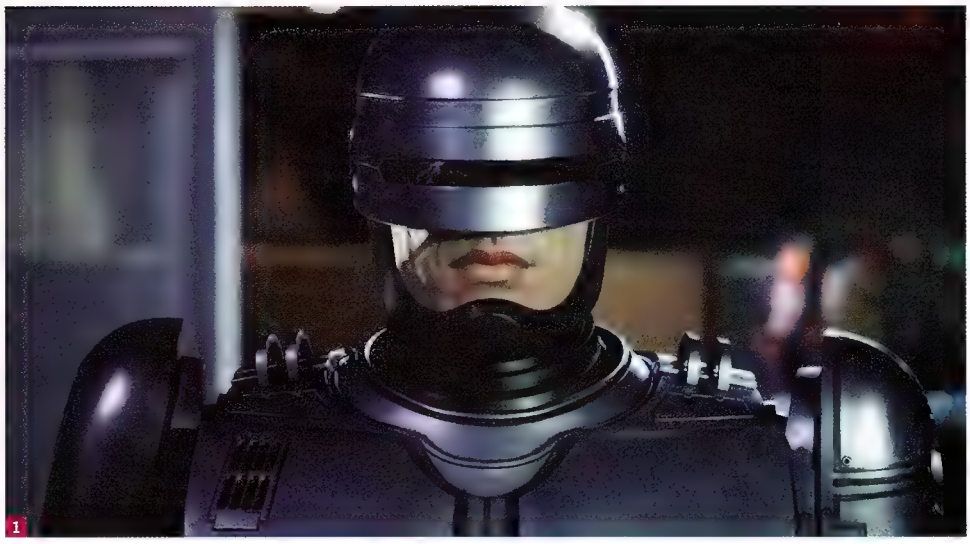
Even now that I've finished the game, I'm not sure how to describe what happens, but it feels a little like cosmic horror. There's a growing desolation that practically inverts the premise of the game, and it's all the more chilling as the phenomena is never explained.

VERDICT



It's not often that a platformer is so ambiguous, so dreamlike and, in the end, nightmarish.

Tom Sykes



1 Your move, Creep.
2 This boss battle against a slow moving Enforcement Droid isn't great.
3 Be prepared for psychological assessments between story missions.

PRICE $73.50 **PLATFORM** PC, PS5, XBS/X **WEB** www.robocop-roguecity.com/en

RoboCop: Rogue City

Engaging, hyper-violent combat only takes it so far.

RoboCop: Rogue City's combat feels like straight up murder: I totally lost it when I punched someone for the first time and RoboCop's fist flew out with the force of a particle accelerator, instantly atomising their skull. There is a tremendous sense of physicality in *Rogue City*. You can pick up enemies by the neck and fling them against walls so hard that chunks of rubble will rain down on their ragdolled corpses. Bullets scatter reams of paper and turn clutter into hurricanes of plastic and metal. Environments are littered with a comical number of explosives, too, that behave in hilariously different ways.

Yes, *Rogue City* has a skill tree system, and it's way too bloated. My advice: get the first tier of every ability ASAP, because they're the juice that keeps *Rogue City*'s combat from getting repetitive. There's *Max Payne*-esque bullet time, flashbangs installed in your eyes and, my favourite, a forward charge where RoboCop plants his feet and surges ahead like a flat-footed freight train, bowling over everyone in his path.

It all starts to fall apart though when *Rogue City* introduces enemies that don't explode with gore – there's a god-awful boss fight against a malfunctioning ED-209 early on, and since you're both two giant, slow-moving tin cans packing nearly identical heat, it boils down to RoboCop awkwardly clambering around the arena taking cover behind too-small pillars.

Between missions you return to the precinct to undergo routine psychological assessments, help fellow officers shuffle papers and just sort of putter around, taking in the sights from the film. he side missions have RoboCop trundling through garbage heaps and pools of water that obscure HP-shredding landmines. It's arduous, and the payoff is rarely worth it either.

Ultimately *Rogue City* doesn't rise above its B-game status in the way that *RoboCop* transcended its B-movie origins. Too often the joy of wasting goons is cut short or delayed by plodding police busywork that rarely plays to the game's strength – character writing.

VERDICT

RoboCop: Rogue City's fantastic shootouts are held back by a dull narrative and bloated pacing.

Noah Smith

PRICE $42.95 **PLATFORM** PC, MAC **WEB** tinyurl.com/APC528sti

Star Trek: Infinite

Stellaris, but not as we know it.

As you may have be aware *Infinite* is very much built on the chassis of *Stellaris*, with some appropriately *Star Trek* twists. Consider it the *Napoleon: Total War* to *Stellaris' Empire: Total War* – a more focused, narrative spin off from a larger and more sprawling game.

The game is set firmly in the *Next Generation/Deep Space Nine* era and portrays the Federation, Klingons, Romulans and Cardassians as four superpowers locked in constant competition. It's not unlike joining a Stellaris game a third of the way in.

Here's the good news: *Star Trek Infinite* expresses the Federation fantasy far better than *Stellaris* ever did. You can genuinely expand by diplomacy here, buttering up minor species and inviting them, one by one. The other playable factions have their own spins on this, like setting up puppet governments as the Romulans.

One of the other big changes from *Stellaris* will be familiar to players of other Paradox games: there's now a narrative structure to the game in the form of a branching mission tree where events can be triggered by objectives. They're as much about steering your playstyle as getting the rewards, and I ended up enjoying them a great deal.

Something *Infinite* should have over any unofficial mod is polish, and while it does feel less clunky than *New Horizons*, there are still more issues than there should be at launch. Like a decidedly un-silent notification for a silent alarm, or the strange bug that caused the voiceover to claim a character had died every five minutes, or the time I ended up with two Rikers. Although to be fair that last one also happened in the show.

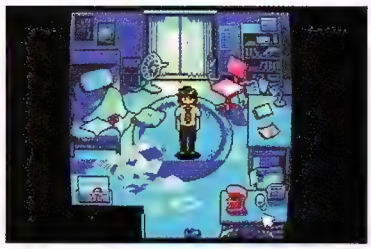
Nevertheless at the end of every review I ask myself, "Do I still want to play this game some more?" and the answer here is yes. I really do want to try that reunification story arc, I want to see if I can evacuate the Romulans before their sun explodes this time (sorry everyone).

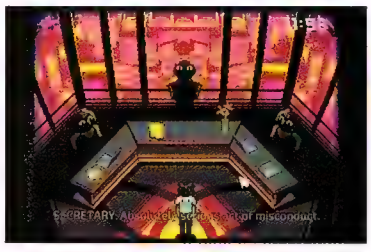
VERDICT

Star Trek: Infinite is compelling, but not quite there yet. It really needs a couple of seasons to grow the beard.

Tom Hatfield

1 "What the hell guys, I thought we all agreed on red torpedoes today." 2 Bajor always starts the game occupied, and positioned between Cardassia and the Federation.





PRICE Free **PLATFORM** PC
WEB bit.ly/TestMojiken

TEST TEST TEST

LIVE, DIE, REPEAT IN THIS PUZZLE GAME.

I love a good timeloop, and *Test Test Test*'s will take some doing to unravel. It's a cryptic, real-time adventure game in which you have 15 minutes to prepare your files for an important work meeting. Fail to retrieve all three files and you'll be fired – with a bullet to the head.

But the moment the bullet lands, time reverts to 11:45. Armed with a little more knowledge each time you reset, can you solve the mysteries of your ominous work environment, find that elusive third folder, and finally please your shadowy bosses?

Puzzles begin simply, as you decipher an anagram on a note and try to get somewhere by a specific time, but before long you're thinking outside the box – outside the game, even – as you follow clues laid by a time-trapped version of yourself, all while battling that harsh time limit.

Sometimes, puzzles seemed ingenious in hindsight – generally, the ones where you're doing things in-game – while the ones that brought in an external source seemed needlessly drawn-out and laborious.

VERDICT

A bit of a plod, and often things just make no sense.

Tom Sykes

The chaingun could use a little more oomph, but it does mince enemies nicely.

RELEASE December 7, 1997 **DEVELOPER** id Software, Nightdive **PUBLISHER** Bethesda **LINK** bethesda.net

Quake II

Rick Lane revisits id's classic in the wake of the remaster.

***Quake II* has a fascinating legacy. Released only eighteen months after *Quake* in December 1997, it was quickly celebrated as the best game ever made. And I mean the best. A technological marvel, it offered a far more focused adventure than the original's dimension-hopping escapades, with a distinctive setting and consistent enemy design. It even had something id co-founder John Carmack had previously dismissed as superfluous to a good shooter – a plot.**

Over time, however, *Quake II*'s reputation has diminished. The following year, its narrative ambitions were superseded by *Half-Life*, which told a better story in a more interesting fashion. More recently, critics have pointed out that its shooting experience is flatter and more sluggish than the 1996 original, while its setting and level design lack the same weirdness and imagination. David Szymanski, creator of the retro-shooter DUSK, has described *Quake II* as "the worst id game".

In the wake of Nightdive Studios' recent remaster, which overhauls *Quake II* for modern machines, the debate over the significance of id's sequel has arisen once more. But the remaster also provides a chance to reappraise *Quake II*. What's interesting is not which of these two viewpoints is correct, but how both are equally supported by the shooter.

Whatever *Quake II*'s own ambiguities, there's no questioning the brilliance of Nightdive's work remastering it. Not only has Nightdive updated the game to make the best of modern PCs, supporting 4k resolutions, widescreens, enhanced multiplayer support and more, it also supports your ideal version of *Quake II*. The remaster supports a whole host of visual modernisations like bloom lighting, dynamic shadows, antialiasing, and enhanced character models. Alternatively, you can turn all this off, switch on CRT simulation and play like it's Christmas Day 1997.

Flexible makeover

It's a wonderful, flexible makeover, and its improvements do help communicate some of what made *Quake II* such a phenomenon at the time. First and foremost are The

"The remaster supports a whole host of visual modernisations like bloom lighting, dynamic shadows, antialiasing, and enhanced character models."
1
2
3

Strogg, *Quake II*'s twisted cyborg adversaries. Quake II's overarching fiction of space marines fighting a race of alien cyborgs may feel a little tired after two decades of similarly-plotted games, but the Strogg's dilapidated, ad-hoc cybernetics that resemble the result of catapulting a body into a scrapheap, help the game maintain some flavour of its own.

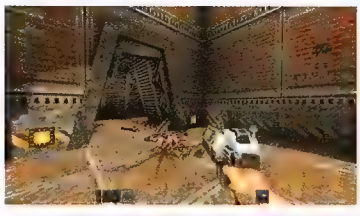
Indeed, one of the toughest challenges in FPS design is creating enemies that are both imaginative in presentation, but also satisfying to fight. With the Strogg, id struck a perfect balance, giving players recognisably humanoid enemies, but with countless variations that all behave in different ways. Taking on a melee-focussed Berserker presents a substantially different challenge from dodging the shoulder-rockets of a heavily armoured Tank. Some enemies I'd completely forgotten about, like the mutant, one of the few opponents that isn't a cyborg, and the Brains, a particularly unnerving cyborg that answers the question "What if WALL-E got infected by John Carpenter's The Thing?"

But the Strogg's most notable characteristic is how reactive they are to damage. Blast a guard onto the ground with your shotgun, and they might take one last potshot at you as they expire. Shoot the head off one of the bulky enforcers, and they spray the area wildly with their chaingun arm before

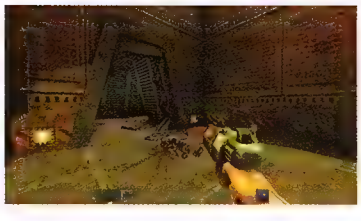
1 Flying enemies are rarely fun to fight, but Quake II's aren't terrible.
2 I've heard of firing blind, but this is ridiculous.
3 Big gun. Bigger skybox.

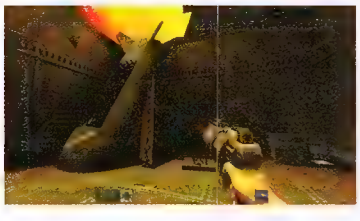
OLD DOGS VERSUS NEW TRICKS

QUAKE II'S REMASTER LETS YOU MAKE THE GAME LOOK AS OLD OR NEW AS YOU WANT.

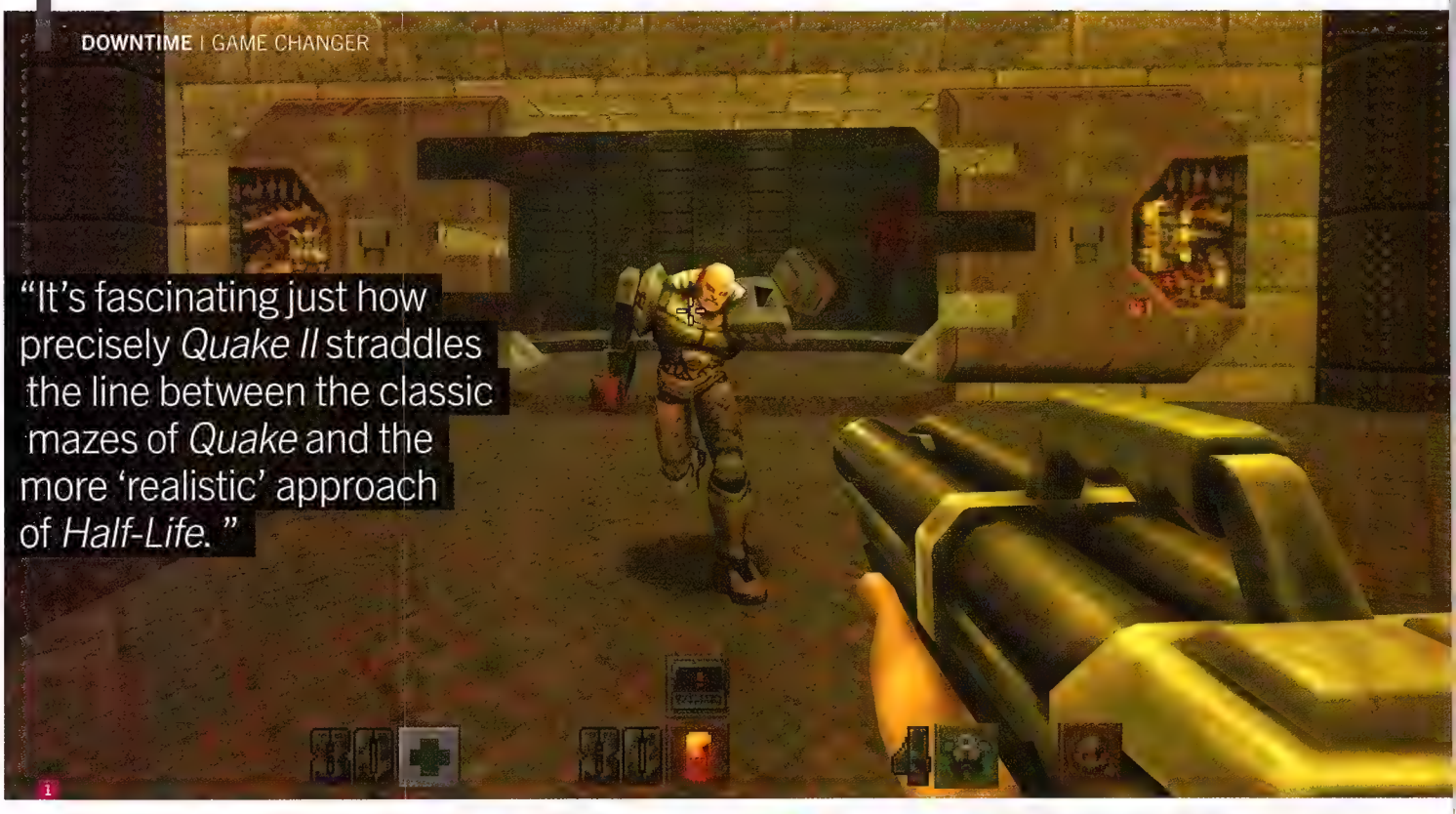


BASIC
Quake II with everything except CRT simulation switched off.





ADVANCED
Quake II with everything except CRT simulation switched on.



"It's fascinating just how precisely *Quake II* straddles the line between the classic mazes of *Quake* and the more 'realistic' approach of *Half-Life*."

collapsing. These detailed animations represented a huge step forward in 1997, and the feature that struck me as the most noticeable step forward when I first played it around its original release. Even today, few shooters afford their cannon fodder such bespoke, imaginative deaths.

These grisly ends don't exist in isolation, either. One of the more striking things about returning to *Quake II* is just how horrible the Strogg world is. This is clear enough in its desolated, brown environments and the Strogg's brutal approach to creating new cyborgs, mercilessly chopping up humans with sawblades and lasers. You can imagine the overwhelming smell of iron oxide as your press through rusting facilities smeared with the blood of your fellow marines. But it isn't the sights or scents of Stroggos that lingers in your mind, it's the sound. The compressed screams of Berserkers as they die, the shuddering moans of your imprisoned comrades turned mad through torture, the buzzing flies that surround a Strogg corpse after it's laid for a while in the alien sun. *Quake II* isn't a scary game, but its monstrously unpleasant world can be thoroughly unsettling.

While the Strogg remain a compelling foe, *Quake II*'s arsenal has aged less well. A few of the weapons still hold up. The super shotgun rightly earns its name,

1 Deep down, he just wants a hug.
2 I could never properly see what these things were back in the day. Now, I just don't want to.
3 Dynamic shadows add an extra moodiness to some areas.
4 Dodge this.

packing a double-barrelled blast that will put a serious dent in most Strogg armour. *Quake II* also introduces the series' defining weapon, the railgun. *Quake III*'s railgun may be more famous for enabling multiplayer frags, but the corkscrew trajectory of *Quake II*'s slugs gives the older game's iteration a more distinctive appearance. Gibbing multiple guards with a single slug also never ceases to thrill.

Most of the other weapons, however, are either slightly or seriously underpowered. The chaingun and hyperblaster are both effective at shredding enemies into strogghetti, but they'd equally benefit from extra kick. The machine gun is still limper than a three-legged possum, while the shotgun is so ephemeral that you're never inclined to use it once you acquire its sibling.

Quake II's greatest weakness, however, is its level design. With the sequel, id Software strived to create a more believable world than previous id games, with objective-oriented levels that designed as recognisable, functional places. Unlike previous id games, many of these levels are connected together to form Units, with you often travelling to and from a central hub level to several side-maps where secondary objectives are completed. The Jail unit, for example, includes a Detention Centre where prisoners are held, a Guard House that serves as the Strogg barracks, and the Torture Chamber is self-explanatory.

It's fascinating just how precisely *Quake II* straddles the line between the classic mazes of *Quake* and the more 'realistic' approach of *Half-Life*. You can almost see the transition happening as you prowl the game's many gun-metal corridors. Unfortunately, id's attempt to hammer the abstractions of classic FPS design into something more grounded results in many of levels looking quite samey. They're still fun spaces to navigate, and there are a few areas that stick in the mind, but for each one are ten brown warehouses filled with brown crates.

IT'S ME, STROGGO!

QUAKE II ENEMIES YOU'D FORGOTTEN ABOUT

MUTANT
The Mutant is a non-cyborg enemy that resembles the Fiend from *Quake*, which is why it's such an odd surprise to encounter on Stroggos.

BRAINS
Appearing toward the end of *Quake II*'s campaign, the Brains look so unpleasant you positively can't wait to forget about them.

MEDIC
Easy to forget because he appears intermittently in *Quake II*, you'll recall the bastard when he resurrects the Strogg you've just killed.

Fundamentals

The limitations of *Quake II*'s maps becomes more apparent when you boot up the remaster's new episode, *Call of the Machine*. Developed by *Wolfenstein: The New Order* creators MachineGames, *Call of the Machine* takes *Quake II*'s fundamentals and uses them to build more elaborate levels stuffed with challenging set pieces. Instead of encountering one or two enemies in every corridor, MachineGames build roomier, more arena-like environments where you'll battle dozens of foes, all carefully selected to press you in new and interesting ways.

Admittedly, MachineGames has a significant advantage in today's more permissive technology. Some of the levels in *Call of the Machine* would have brought the average PC to its knees back in 1997. But *Call of the Machine* also much better understands how to build encounters around specific weapons or enemy-types. In particular, *Call of the Machine* is a railgunners delight, regularly funnelling you through tight corridors stuffed with weaker enemies just desperate to be gibbed, or placing Gunners on distant, elevated platforms that require a precisely planted slug to take down.

Call of the Machine is intense and frenetic in a way *Quake II*'s campaign rarely is. Yet while not entirely successful, *Quake II*'s Units are nonetheless an important landmark in FPS design. *Half-Life* is often characterised as a revolutionary moment in the history of the shooter, a completely unanticipated event that shook the whole industry. But *Quake II* shows the ideas *Half-Life* executed so brilliantly were very much in the water at the time. *Quake II* might not thread together its levels in a contiguous way. But it nonetheless succeeds in making Stroggos feel like a specific and coherent place, one that has grimly logical reasoning behind its form and function.

And while the game's premise is trite by today's standards, the execution still holds up in a lot of ways. The satellite-view briefing cutscenes that fill the gap between missions, presumably influenced by Westwood's work on *Command & Conquer*, are a great way of contextualising your progression without getting in the way of the action. Similarly, the framing of your adventure around specific objectives, rather than simply finding your way to the end of the maze, effectively communicates your role in undermining the Strogg war effort. Although you only ever glimpse the broader war around you, you nonetheless feel like part of something greater than yourself.

Rather than being a singular event, Valve's shooter was just another step down a path that games like *Quake II* and *Duke Nukem* were already traversing. In that context, it's much easier to see where *Quake II*'s exuberant reception came from. Its reactive enemies, its more narrative driven campaign, its interconnected levels designed to resemble a place, all of these were significant advancements in FPS design.

Quake II felt tangible, believable in a way no shooter ever had before. Nobody was to know that something even more realistic lurked beneath the deserts of New Mexico, ready to be unleashed a year later. Today, *Quake II* might represent an intriguing evolutionary link between *Quake* and *Half-Life*. But for a few months in the rapidly changing development scene of the 1990s, it was the most advanced shooter anyone had ever made. ■

Total recall

Unearthing games that never were

For 30 years, Frank Gasking has been on the hunt for unreleased games. David Crookes catches up with gaming's digital detective.

If anyone can be called a connoisseur of videogames, it's Frank Gasking. One of his favourites is *Deadlock* for the Commodore 64. "When you look at the game and its level of detail, it's one of the best-looking titles ever seen on the computer thanks to the artwork of Robin Levy," Gasking told us. "It was made a few years before *Super Metroid* came out on the SNES and it's almost like the team from that game had seen *Deadlock* running. Of course, they hadn't."

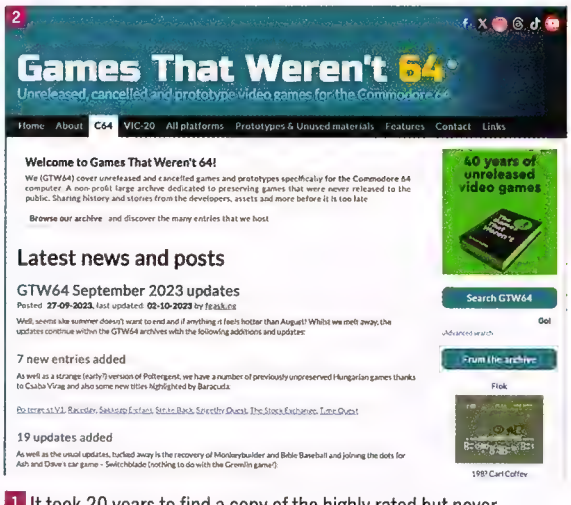
There's a strong reason why he's so convinced that the team behind one of Nintendo's most iconic games couldn't have drawn inspiration from *Deadlock*. The latter game was never actually released. Like so many titles over the years, it was put in limbo, with the axe eventually falling in 1990. "The major stumbling block was that the game design was far too ambitious and got messy, so it lost its way," Gasking said. Yet it still remains a firm favourite to this day.

One of Gasking's hobbies is unearthing gaming treasures, and he'll go to great lengths to track down information about games that never saw the light of day. In some cases, that's as far as it gets: disks, cassettes and hard drives are lost, wiped or corrupted, seeing hours, days, months or even years of hard work vanish without a trace.

1

There are times, however, when development assets or even complete games are mined from dusty attics and basements. And when they are, the impact can be huge. "When remains of the first iteration of *Total Recall* for the Commodore 64 were recovered recently, it completely blew up around the internet due to its link to the popular film," Gasking said. "It was only an early preview without a huge amount to show but, because of the link to Arnie, it caused a bit of a stir."

In the case of *Deadlock*, Gasking had received an email from the title's developer, Dan Phillips, in 2000 promising to share early



2

1 It took 20 years to find a copy of the highly rated but never released *Chuck Rock*. 2 The website contains details of unreleased titles plus downloads of rescued games.

previews of the game. Three years later, permission was granted to distribute the previews to the public, who were finally able to see how well the game had been shaping up.

"Had the team figured things out with the design and properly turned it into something playable, this really could have been something special back in 1990," Gasking said, believing it would be a true game-changer. "No doubt, it would have raised the bar on the platform." It's finds such as this that help explain his motivation.

In the zone

The drive to find unreleased games began 30 years ago when Gasking, who now refers to himself as a gaming historian, read an article by journalist Ian Osborne in the May 1993 issue of *Commodore Force* magazine. Entitled "That Was The Game That Wasn't", the piece looked at various games that had been advertised "yonks ago" but were yet to find themselves on shop shelves.

"It was the first time I had heard about the concept of unreleased games," Gasking said. "I started asking around to see if anyone had any of the games shown in the article, and my late friend Jason Kelk kindly put together a disk containing a few of the titles – the first one I remember loading was *Alloyrun*, which was a complete, neat sideways-scrolling shooter that had this memorable scene of a band playing in time to the music on the title screen.

"I clearly remember the buzz and excitement of playing a game that I wasn't supposed to, but also wondering how it could be possible that complete and playable games could go to waste in this way. From that point, I wanted to try and find the other titles mentioned in the article but also look for other games that may have befallen a similar fate. Little did I know how that original article was merely scratching the surface."

At first, leads were gained from magazines. These were the days before the internet had taken hold and Gasking had only a few contacts, primarily in the Commodore 64 scene. "At this stage I was learning of titles that had been cancelled or had disappeared without a trace," he said.

"In the early days, I was also just asking my friends and contacts via phone and letter if they knew anything more about them and if they perhaps even had copies. Thankfully a good chunk of them were out in some shape or form, and over time I started to amass a small collection of previews/full games across various disks."

Gasking's endeavours expanded when he wrote a regular feature for the fanzine, *Commodore Zone*. "This led to others in the scene providing titles to cover in future articles," he said. But the hobby truly took off once he was connected to the internet at home and bagged himself some webspace. "This was around 1998-99, and I was doing an IT course at college and learning about HTML.

"I set up a basic site to cover Commodore 64 productions I was creating myself and I had a section called "Games That Weren't". It contained small entries on the games I'd covered in *Commodore Zone*, with downloads to previews and full games that I'd managed to find. I also started to find other cancelled games through FTP sites that contained Commodore 64 downloads."

ABOVE *Total Recall* for C64, recently re-discovered to the delight of the internet.

ABOVE Frank Gasking, unreleased game hunter.

"When remains of the first iteration of *Total Recall* for the C64 were recovered, it completely blew up around the internet"

Making tracks

As well as sharing an assortment of goodies, which included art assets and sound files, the website contained entries of games that were still "at large" and for which information remained scarce. By listing them, more and more people sought to assist, and ex-developers and artists got in touch via the website to offer more details. Some would send unreleased games or offer to loan disks for Gasking to preserve. There was still much work to be done.

"During the early days, I would gather credits from the magazines and through user contributions via email and then search for people in the hope they had created a personal web page or had a presence of some kind," he recalled.

"I also looked at online directories to try and find postal addresses and I would send off typed-up letters through the post in the hope of a reply," he continued. "This, of course, was before the days of Facebook and LinkedIn, which would dramatically change my process of trying to track people down.

"As time went on, pretty much everyone went online and could be found in some shape or form, and then election roll data started to pop up, too. The more people that appeared online, the more outreach you had to contact those involved directly, but also those who knew the people you were trying to reach out to."

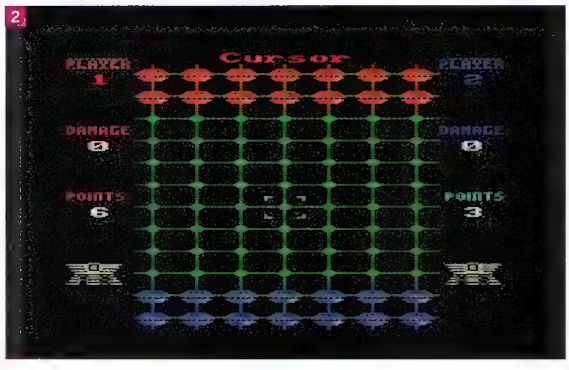
This is generally how Gasking works today, revealing the fruits of his labour on the dedicated website gamesthatwerent.com. Most people are found through social media and via contacts (or contacts of contacts). In some cases, he'll find someone's place of

work and use a company's contact form. In other cases, he'll continue to scour the electoral rolls. "Sometimes we don't have much luck and then, out of the blue, the person in question discovers our page on one of their games – that's what happened with *Total Recall*."

One thing he won't do is pester or make a nuisance of himself. "I will keep persevering until I hit a brick wall, where we can't go any further and have exhausted all possible, or known, leads at that point. If we do manage to find someone involved and they don't wish to help or be involved, then we respect their wishes, simple as that. Constantly harassing is only going to keep the door more firmly shut and, sometimes with a bit of respect and patience, people can change their minds," he said.

Extra lives

Time can be a problem. On the one hand, Gasking and his growing team may find they just don't have enough hours in the day to devote to chasing down developers and the numerous other people involved in past games. "It can be quite an involved process, and it's sadly not possible to delve deep on every single entry we have in the archive, so we'll usually spend more time on the titles that we have a particularly keen interest in," he said.



1 The article in *Commodore Force* magazine that inspired Gasking. 2 You can play Crystal X's lost game *Cloaker* via the *GTW* website.

Despite ads such as this, *Murder!* for the C64 was never released – and has never been found.

On the other hand, it may not be an ideal time to catch a game maker's attention. "Some may be tied up with big-name publishers and, having signed NDAs, they may not be wishing to risk anything that could affect their main source of income. That may change at a later date if you're lucky, though, of course, in some cases it may mean you never get to learn more about a particular title and details could be forever lost to time."

Despite the time-consuming processes and the disappointments involved – "the process can easily turn into a bit of a rabbit hole and require a lot of detective work" – the triumphs make it all worthwhile. Visit the website and you'll find close to 2,500 entries, some of which made their way into a mammoth 644-page book called (what else?) *The Games That Weren't*, published by Bitmap Books.

New entries are being added all the time. Recently a bunch of Hungarian games, including an early version of Poltergeist, were preserved, as was an early game by Swedish coder Karl Hörnell, programmer of several games published on the budget label Players in the 1980s. Entries are also being constantly revised, helping to bridge gaps in gaming history. It all started by chasing down unreleased Commodore 64 games, but now any title on any platform is given the same treatment.

"One of the many other non-C64 games we have covered was *Half Life* on the Dreamcast," Gasking said. "Apart from the slightly dodgy loading times, this was a seriously impressive conversion that improved on the original game in many ways, and was due to be the first to have the exclusive episode of *Blue Shift* included as extra.

"I honestly think that had the game been developed a year or so earlier and got released before SEGA pulled the plug on the Dreamcast, then this could have helped change the platform's fortunes, or at least kept things going a little longer."

The Holy Grail

As expected, this went down a storm with retro gamers, and it's not entirely uncommon for unearthed assets to be dusted down and worked up into a complete game. Legendary 8-bit developers the Oliver Twins have proven to be dab hands at such endeavours – in 2015, they found the source code and graphics to one of their past games *Wonderland Dizzy* and enlisted a Polish *Dizzy* fan called Lukasz Kur to convert the files into a working ROM image. Such efforts are always appreciated.

"Sometimes it can just be the inclusion of an entry about a game that triggers the person in question to dig out their sources and finish things off," Gasking said. "We've seen this, for instance, for *The Wild Bunch* by Jon Wells, and also *Outrage*, which was released recently by Psytronik Software on the Commodore 64.

Unearthing treasures

Of all the games that he's recovered, two stick in Gasking's mind the most: *Solar Jetman* and Hi-Tec Software's *Daffy Duck*. "Some people are probably sick to death of hearing about the recovery of *Solar Jetman*," Gasking laughed. "When I first heard that a C64 conversion of the game had been planned, I had no idea that it was anywhere near complete but, when artist Haydn Dalton got in touch to confirm he worked on it, and that it was in fact complete, I was stunned.

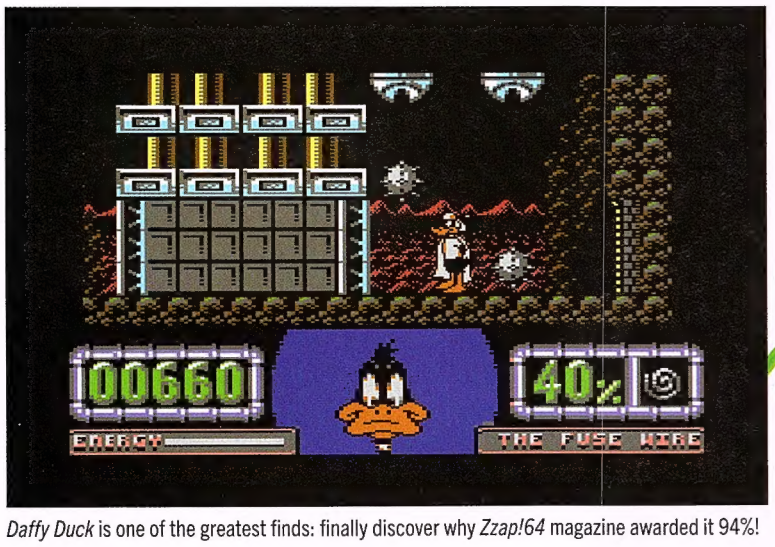
"He revealed who the coder was (John Buckley), though sadly both John and Haydn had nothing of the game at all after several searches. Then one day, Haydn was about to move abroad for a new role and was clearing out his house. Stuffed behind an old radiator was an old briefcase, which when opened revealed leaflets and memorabilia from computer shows in the 1990s. "Inside were two disks, with labels indicating that they contained a build of *Solar Jetman*, along with a disk containing graphical assets. Haydn suggests this must have been a build they took to a show and was forgotten about. He duly sent the disks down to me via secure post, and it wasn't long before I was seeing his loading screen pop up on the screen with a wonderful piece of Geoff Follin music playing.
"I still remember being in shock at seeing this glorious NES conversion running for the first time, after never seeing even a screenshot of it in the press at the time."

Daffy Duck was also presumed lost, with Gasking having searched for the game for a staggering 18 years. "There had been many fake reports of people owning prototypes, but the developers that we managed to track down no longer had anything of the game. Even Hi-Tec's owner Dave Palmer couldn't find anything (although they did find a build of *Bugs Bunny: Private Detective* to put up on the site).

"When all seemed lost, I had decided to cover the game one last time for my book. I got in touch again with artist Ashley Routledge to ask some questions and mentioned the possibility of finding something of the game after all this time. I just expected Ashley to cover our previous searches with him and how it hadn't been successful, but then he surprised me by saying that he'd recently spotted his disks at the back of his attic."

Having offered to preserve Routledge's disks, Gasking went to collect them. "Ashley had forgotten that his coding partner Dave Saunders had given him a full set of backups of all his code and it included all of the source code to *Daffy Duck*.

"I remember seeing these disks with Ash and Dave, and Dave turning to me and saying, 'I think you've struck gold here!' We certainly did, and after a few months of hard work with Martin Pugh and David Simmons, the game was fully re-built, tested and released (finally!) in 2015."



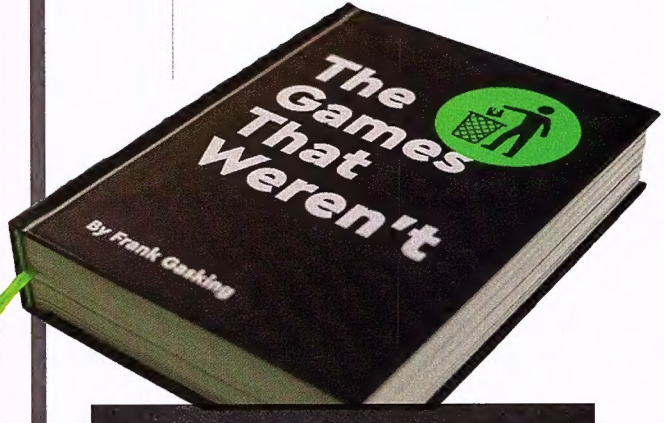
Daffy Duck is one of the greatest finds: finally discover why *Zzap!64* magazine awarded it 94%!

"Sometimes it can just be the inclusion of a game that triggers the person in question to dig out their sources and finish things off"

"Thalamus Digital has also recently expressed an interest in finishing off a title called *Bomb*, which was being created by some ex-Domark developers (Tony and Chris West). This was triggered by a preview gameplay video we posted on our social media channels even though the previews had been on the site for almost 20 years prior to that."

Despite such successes and decades of hard work, Gasking remains motivated. Healthy sales of his book increased the level of interest in finding unreleased titles and it has lent more weight to the website. "It gives that little bit more trust when we offer to help preserve disks and other media," he said.

There are also many games still unaccounted for. "The biggest holy grail for us is *Murder!* for the Commodore 64 by U.S. Gold, which might be the one which defeats us – we've exhausted pretty much all avenues and there are very few other options now for trying to find the game," Gasking said. "Other titles include *Mire Mare* and *Bandersnatch* on the ZX Spectrum and the practically complete iteration of *Green Lantern* for the Super Nintendo. I just wish there were more hours in the day to cover and preserve everything." ■



The Games That Weren't book was recently reprinted and can be purchased from tinyurl.com/APC528games

CHIP CHAT

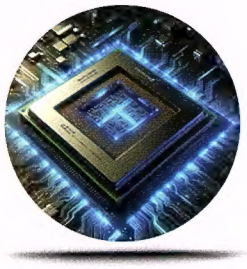
Joel Burgess reports on the unusual side of tech news

© Microsoft

MICROSOFT ROLLS OUT WINDOWS XP UGLY SWEATER

IRONIC MERCH TO KEEP YOU WARM AFTER THE AI APOCALYPSE.

While in Australia you're more likely to want a human-sized water cooler than what the Yankee Doodle's call a sweater, Microsoft has a running gag for its Northern Hemisphere brethren of releasing a Windows-themed ugly sweater for the festive season. This year's edition features the bland hillside background of the popular Windows XP OS. While we're not sure the default background was the crucial ingredient in that operating system, at least this ugly-jumper will be able to keep you warm when Copilot has reached the later stages of the AI apocalypse.



© MS Copilot

USER CREATES RAM FROM AMD 3D V-CACHE

IT'S ONLY 32MB BUT CLOSE TO FIVE-TIMES FASTER THAN DDR5.

In a purely academic pursuit, Twitter/X user Nemez created an ultra fast RAM module using AMD's onboard 3D V-Cache that ends up being around 15 times faster than the top PCIe 5.0 NVMe SSDs. This is roughly 10 times faster than DDR4 and just under five times what the latest DDR5 can achieve. Despite this responsiveness, the 32MB capacity is a little low to be useful in any real capacity, but it does beg the question of whether it could be an avenue worth pursuing if AMD wants to compete with Apple's Unified Memory.

© NovelKeys_

NovelKeys_ Pyramid and sweary keycaps

A novel solution to rage quitting.

We're not sure exactly what NovelKey's motivation for creating a pyramid shaped Esc key was. The black sun insignia on it could be a reminder that leaving whatever you're doing isn't the end of the world, or it may simply be a keyboard defence mechanism for 'rage quitting', but whatever the reasoning, there will be a stabby cost to your finger if you push it too forcefully. The Cherry keycap manufacturer clearly has a kind of pyramid scheme of its own going on since it also sells a 'Fk Off' Enter key, presumably for guiding your compounded rage when you do stab yourself trying to hastily exit something.**

"The Cherry keycap manufacturer clearly has a kind of pyramid scheme of its own going on since it also sells a 'F**k Off' Enter key"

JAPAN DEBUTS APPLE-FLAVOURED THERMAL PASTE

THIS FRUITY THERMAL PASTE WANTS TO BE THE FILLING OF YOUR CPU-COOLER SANDWICH.

Japan-based gaming rig builder Clock Work Tea Party has released a limited edition apple-scented thermal paste. Why? Um, we have NFI. The website claims the 'naturally derived apple scent and green colour' make it easier to see on a CPU… but not being able to see thermal paste is hardly an issue the internet was pleading for a solution to. At least if it was orange or matcha flavoured we'd know it was a riff on the company's name, but there's not even an association with anything Mac based, it just exists so you can stop and smell the thermal paste.

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- IPv6 & IPv4
- 2 x VPN tunnels including 2 x SSL-VPN tunnels
- IPsec VPN throughput at 200 Mbps (AES 256 bits)
- Integrated IEEE 802.11ax (AX3000) wireless Access Point (ax model)
- 2 x FXS VoIP (Vac model)
- Support VigorACS 2 and VigorACS 3 Central Management Systems for remote management
- Central AP Management for up to 2 Vigor Access Points
- 2 years back to base warranty

Vigor167

VDSL2 35b Supervectoring Modem/Router with 2 x GbE LAN ports

- 1 x VDSL2 35b Supervectoring / ADSL2+ WAN port
- 2 x Gigabit Ethernet LAN ports
- Two Operation Modes
  - > VDSL2/ADSL2+ Bridging Mode
  - > Router Mode
- VDSL2 35b download speed up to 300 Mbps
- IPv4 Static Routing
- Supports VigorACS 3 Central Management System for remote management
- 1 year back to base warranty

i-LAN TECHNOLOGY

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